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*" To the solid ground*
*Of nature trusts the Mind that builds for aye."*—WORDSWORTH.


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## CORRESPONDENCE

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"To the solid ground
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# Religion—a Changing Force?

IT will always be a paradox that the gentlest and most lovable character in the whole of the recorded history of mankind should not only be the source of such bitterness and hatred as mark the story of Christianity, but also that He Himself should have been fully aware that the consequences of His teaching would constantly be averse from the spirit of His doctrine. Of all the utterances of Our Lord, that which displays most clearly His insight into the heart of man, and has been most completely fulfilled, is the declaration that he brought into the world not peace, but a sword. Not only did He knowingly set up insurmountable barriers between those who followed Him and their families, friends and fellows in the community, but also when He turned from the Jews to send the seventy disciples on their mission to the world, He informed His religion with an inflexible will to the conversion of the heathen—in other words, of those not of like belief—which in its methods and its results has belied the promise to mankind of peace and goodwill.

Too often in its history, the missioner of Christianity has been of the type of the inquisitor and the conquistador; the fate of its converts a degradation and an extinction no less complete in its results, if less drastic in its methods, than the fate which overtook so many of the Indians of Mexico and Peru. Not indeed that Christianity here stands alone. The first great tragedy of Calvary was a prelude to the beasts of Ephesus, the spectacular slaughters, the crucifixions and the pyres of Rome. If that tragedy was re-enacted time and again in the sectarian quarrels of European civilization through the ages, elsewhere, to name one instance only, the Moslem world enlarged the circle of the Faithful by the persuasion of fire and sword.

A post-War generation, weary of strife, in its desire to build "a brave new world", would have consigned all such antagonisms to the limbo of errors and absurdities of an outworn dispensation. Frank and open discussion of differences, and co-operation, despite these differences, of all of good-will in the promotion of common aims, were to take the place of sectional rivalries and obstructions. Leagues of intellectual co-operation, and international conferences and congresses sprang up on all sides to discuss and deal with every kind of problem which stood in the way of the advancement of mankind—moral, intellectual and social. The events of more recent years have brought a bitter disillusionment to those who thought that Armageddon had passed and the millennium was due to arrive.

The present, however, is no time for pessimism; and least of all does it befit science either to belittle what has been effected by co-operative effort since the War—and the sum total is by no means

negligible as the record of the non-political activities of the League of Nations can show—or to despair of the endeavour which is being made to keep open some of the ways to interchange of thought and mutual assistance, at a time when differences of outlook and tradition are being emphasized and barriers of mistrust are being re-erected. There are still matters of universal significance for mankind in which the co-operation of all may be invited, if indeed it be not essential.

Yet, however strong the conviction that a sturdy, and at times dogged, optimism is the only creed for the man of science, as well as a necessary condition of constant progress in the understanding of Nature and the universe, there are whole departments of thought, with their corollaries in human conduct and affairs, from which the principle of universality, which is a condition of world-wide co-operation, seems to be excluded. Co-operation rests, ultimately, on a truth which, in a scientific sense, is universal—in fact, a 'law'. This is the ultimate principle, whether in dealing with the suppression of the drug traffic or with 'sanctions'. But in the field of religious beliefs, on a detached view, truth is relative to the object of belief, and departmental. The code of thought, and its materialization in action, which befits the Buddhist, cannot be reconciled with that of the Christian, however near their approach.

More than passing interest, therefore, will be aroused in many not directly concerned, and irrespective of religious belief, by the announcement that during the early half of the month of July representatives of the more important religions of the world are gathering in London at a World Congress of Faiths for the discussion of "World Fellowship" as a way to the solution of world problems—the problems of war and of social and economic difficulties, which seem inevitably to lead to disaster. Neither the validity nor the possibility of fusion of the religions represented will be under consideration; but each religion is invited to consider how, maintaining its individuality, it can best contribute to the common end.

The organization of the Congress, which opened on July 3, fully maintains the claim that it is both international and inter-religious. The international president is H.H. the Maharaja Gaekwar of Baroda, and the chairman of the British National Council is Sir Francis Younghusband. The chairmen, speakers and openers of debate at sessional meetings have been selected with strict impartiality for their ability to further discussion, without preference of creed. For the attainment of what may be taken to be the more general purpose of the Congress, the dissemination over the widest possible field of a knowledge of the varied lines of approach to the major problems of existence among different peoples and creeds, the greatest importance must be attached to the series of public meetings at which distinguished members of the Christian, Jewish, Buddhist, Hindu and Moslem religions, as well as of independent thought, will expound their respective conceptions of "The Supreme Spiritual Ideal".

To bring together representatives of these different faiths, some of which, it might be thought, would mix as readily as oil and water, for the discussion of such a topic as "world-fellowship" is in itself no mean accomplishment. It does at least lend some colour to the expectation of a not entirely unfavourable answer to the inevitable question, whether any practical outcome is to be anticipated from this attempt to secure co-operation among the more liberal spirits of the various religious beliefs in the solution of world problems.

In view of the past history of religious animosities, the whole project may seem Utopian, the forlorn hope of enthusiasm. Has the time really come when the lion will lie down with the lamb? Have these religious differences been composed, and is the *odium theologicum* a thing of the past? Perhaps we may construe current events as a turn in the tide. In the Education Bill which has now passed through Parliament, for example, we seem to be entering upon the final phase in a settlement of a denominational religious difference which has been an obstacle to progress in popular education for well over a hundred years, and a source of social disintegration for three times that period. The Church of England, it is true, failed to reach a satisfactory conclusion in its overtures to the Orthodox Church; but in other directions, as for example, recently in Finland, it has been more successful. Do these movements and others of a like character point to a weakening of the religious fibre, manifested in a lessening of the spirit of aggression, or do they represent a further stage in progress towards a higher development of religious activity?

To attempt an answer would involve a combination of prophecy and analysis which would be neither profitable nor appropriate here. This much, however, may be said. Religion as a social phenomenon, and not as an individual experience,

as the student of religions well knows, is a sublimation of group solidarity. In a supreme self-protective effort it either proselytizes, expels, or exterminates: hence missionary effort and persecution, on the principle that he who is not for is against. This lies at the root of the quarrel of Nazi nationalism, a quasi-religious emotion, and the Confessionals in Germany, just as it inspires the persecution of the Jews. The Old Testament expresses it repeatedly in the reliance of the Hebrews on Jehovah, the god of battles, as the exclusive protector of the Chosen People.

To some extent at the present time this particularist spirit of self-protection has been diverted into the channel of nationalism. More potent, however, is the fact that an ever-increasing number, appealing in the conditions of modern civilization to a widening circle, is not content to rest in the particular, but must pass on to the universal. To such, neither restrictions of national distinction nor differences between creeds can weigh in the balance against the ethical principles explicit or implied in all the higher forms of religion. In this composite but practical creed, analogous to the *jus gentium* of the legists, it may be that they are feeling their way towards a further and higher stage in the development of religious belief, in which the theological differences which antagonize will be forgotten in the pursuit of a common and universal ethical purpose.

# Colonial Policy and Scientific Research

MR. ORMSBY-GORE has lost no time on taking up his duties as Secretary of State for the Colonies, in making clear his personal position in relation to a variety of problems with which he is confronted in colonial administration, and more particularly to the need for the active prosecution of research with a view to future development.

An address which he delivered recently, when presiding at the thirty-fifth annual Colonial Service dinner of the Corona Club, was broadcast, and was no doubt consciously directed to reach a wider public than his immediate audience. It will go far to allay some not unjustifiable feelings of uneasiness as to future developments, which for some time have disturbed informed opinion both at home and in the Dependencies. While Mr. Ormsby-Gore deprecated the discussions, in which the possibility of future sessions of territory had been debated, as likely to do more harm than good, he was emphatic in endorsing "the very clear statements" of the Prime Minister and of his predecessor in office, referring specifically among other dependencies to Tanganyika Territory. "Peace," he went on to say, "continuity of policy, social progress, and economic development are the greatest needs of the Colonial Empire."

With this all will agree, although there may be difference of opinion as to the best means by which they are to be attained. It is significant, however, of the confidence inspired by Mr. Ormsby-Gore's appointment, that it has made optimistic even so sturdy a champion of the white settlers' claims in Kenya as Lord Frederick Scott, who, as he told the East African group of the Overseas League on June 18, sees hope for the future in the appointment of "a new Secretary of State for the Colonies, who knew East Africa, and had written . . . the best of all reports on East Africa".

While Mr. Ormsby-Gore is fully alive to the part which has been played, and must continue to be played, by the study of native institutions in their bearing on the further development of the native, there are two matters to which he directed attention as problems of public health confronting the Colonial Governments. Of these the first is the application of the newer scientific knowledge of nutrition. Mental and physical efficiency, as well as resistance to disease, he pointed out, are tremendously affected by nutrition; and he is not satisfied that the problems of nutrition have been adequately studied and the results applied in our tropical dependencies. After a reference to the generous offer of the Rockefeller Foundation to establish a special organisation in Uganda for the study of yellow fever, he spoke of the benefactions received by many Colonies from the Carnegie Corporation of New York, particularly in connexion with education, social services and libraries.

It is especially satisfactory to hear that Mr. Ormsby-Gore intends to devote his personal attention to the application of science to Colonial problems of agricultural development and public

health, and to watch with a vigilant eye the work of the education departments throughout the Colonies. In this connexion it may not be inopportune to note that Lord Linlithgow, Viceroy of India, in addressing the opening meeting of the Advisory Committee of Nutrition under the Indian Research Fund Association at Simla on June 18, referred to the relationship of improvement in sanitation, hygiene and nutrition among the rural population to literacy among the women: "In default of female literacy," he said, "it will be found that, whenever supervision is removed, there will be a relapse into age-old customs, and that within a few months nothing will be left of the better living that has been so laboriously inculcated." The experience of India in the past ten years may not be without its lessons for the colonial administrator.

# Land-Reclamation in Italy

**Land-Reclamation in Italy:**
Rural Revival in the Building of a Nation. By Cesare Longobardi. Translated from the Italian by Olivia Rossetti Agresti. Pp. xii+243+29 plates. (London: P. S. King and Son, Ltd., 1936.) 12*s*. 6*d*. net.

ONE of the achievements of which Fascism can unreservedly be proud is the reclamation of great areas of land in Italy that for centuries had added little or nothing to the national wealth, and indeed had frequently, like the Pontine Marshes, been dangerous to human beings owing to the widespread prevalence of malaria. Waste land can be found in all countries, even in our own, densely populated as it is; it escaped enclosure in the old days because it could not be cultivated by the methods then in use. Considerable areas are, however, amenable to modern methods of cultivation, though the cost of reclamation might be too high to permit an economical return on the money expended. For this reason land-reclamation is scarcely proceeding at all in England, though occasionally private individuals embark on the enterprise out of sheer love of the work. In Holland the great Zuyder Zee scheme is being financed by the Government, but it is regarded not as a financial but as a social investment, to provide land on to which the growing population may spread. In the western European countries the problem is complicated by the many private rights which, though long in abeyance, may burst into vitality as soon as there is any suggestion of the land being developed or taken over for public purposes. In countries ruled by a dictator as in Italy and Russia, such questions do not arise, and land-reclamation becomes simply a technical problem which can be carried out regardless of cost.

One of the greatest of the Italian schemes was described by Dr. Roberto Almagia in NATURE of June 15, 1935. There he shows how the great Pontine Marshes have been converted from malarial swamps into good farming land. The present writer visited this region in April 1934 and was greatly impressed with the efficiency of the work and the adequacy of the houses and farm buildings. Hitherto it has been difficult for English experts to obtain information on the many administrative and financial problems involved. These are satisfactorily dealt with by Señor Cesare Longobardi, so that we now have a full account of the procedure and some statement of the cost of the work.

Reclamation has progressed rapidly since the Fascists came into power. In their first years of office, some 5,000,000 man days were given to this work; in 1933–34, their twelfth year of office, this had increased to nearly 18,000,000 man days. Some 4·7 million hectares are already in hand or completed, and marked increases in output of agricultural produce have already been obtained. The production of wheat, which before the War was less than 5,000,000 metric tons per annum, has risen to nearly 7,000,000 tons; net imports of wheat, formerly 1·4 million tons per annum, fell in 1934 to 235,700 tons only.

The Italian reclamation schemes extend also to the land which, though cultivated, is not properly utilized, especially to the well-known latifundia, agricultural properties on which farming is extremely primitive and extensive, where the farms form "a compact mass untraversed by roads, with no water system, infested by malaria, with hardly any permanent inhabitants". The latifundia are associated with what is known as the 'Southern Question', the group of problems arising out of the backward economic and social development of the south of Italy and the islands as compared with other parts of the country.

The general machinery for the reclamation is prescribed by the Mussolini Act which characteristically, as the author states, "does not lose itself in the maze of existing measures. It leaves them as they are and goes straight forward". It

makes financial provision over a period of fourteen years for work amounting to 7,000,000,000 lire; it directs special attention to works nearing completion; and it opens the way for further developments which experience may suggest. Of the 7,000,000,000 lire, 4,300,000,000 was to be chargeable to the Treasury and the remainder to the land owners. The major part of the finance is provided in the form of 30-year annuities discounted to the parties concerned by several different institutions. The whole of the money has already been taken up, but there still remains much work to be done.

The author states that the Act was received with great enthusiasm by the whole country. The projects submitted would have cost in the aggregate ten or fifteen times the amount available, and therefore rigid selection had to be exercised. The rights of the owners were in principal acknowledged, and, where curtailed, were said to be adequately but not excessively compensated. Preference was given for the execution of the work by consortia of landowners or public bodies, which appear to be something like the public utility societies of Great Britain. This method avoided the danger of supplanting private initiative by State intervention; at the same time it prevented the work from stopping directly the Government had fulfilled its part of the contract and before the landowners had completed theirs. The procedure is dealt with at considerable length. A special section of the Ministry of Agriculture deals with land-reclamation, and receives proposals or itself draws up plans. No project is accepted unless it shows considerable possibility of securing notable improvements in hygiene, demographic, economic and social conditions.

The plan being accepted by the Government, the landowners proceed to execute the works either themselves or through the consortium. They may provide all the money themselves or obtain Government grants or special loans from the agricultural banks. The arrangements seem to be very elastic. A very active body, however, is the National League of Ex-Service Men (Opera Nazionale per i Combattenti), whose name one sees painted up on the buildings in many of these reclaimed areas. The League has special privileges, and can demand the expropriation of landowners even if they are ready to reclaim the land. Whatever is reclaimed by the League is used for small holdings on which ex-Service men or their families are settled. Mussolini attaches great importance to this body as being, in his own words, "mobilised to perform a task with the urgency of which I am more than ever impressed, that of ruralising Italy". When the reclamation is completed, some internal migration and land settlement become necessary; a special commissariat exists to organise this. The migrants are mainly farm workers brought from more densely settled regions; in 1933, for example, some 15,000 farm workers were moved but only 500 industrial workers.

Economic law, however, still seems to operate to some extent in Italy, for we are told that the serious fall in prices of farm products after 1929 made it impossible for the landowners in some years to meet their share of the cost, and consequently Government help had to be given. The portion of the costs chargeable to the landowners is divided between them in proportion to the advantage accruing to each as a result of the work. It is impossible to ascertain this precisely beforehand, hence a provisional apportionment is made and adjusted when reclamation is completed. The credit is held against each landowner by the consortium in the form of 30-year annuities, which rank as a charge on the land immediately after the land tax and the provincial and municipal surtaxes. As the landowners themselves were unable to pay the necessary money, various banks were established for the purpose of enabling them to do so.

Considerable details are given in regard to the larger schemes. The great Pontine Marsh is cut up into holdings of 25–75 acres according to the quality of the land, each furnished with a house, stabling for ten cattle, poultry run, pig sty, well, etc. The Ex-Service Men's League has obtained grants for the settlement of some 100,000 acres. Families are brought by the Commissariat for Internal Migrations; as they have no capital, the farms are taken from the League on a crop-sharing plan, the tenants receiving monthly advances in the shape of supplies and cash allowances from the League, which directs the management of the farm. When the head of the family has acquired the necessary experience and has returned the advances made by the League, an agreement is to be drawn up under which he will purchase the farm and the livestock from the League in fifteen annual instalments covering capital and interest at the official bank rate. The farms are grouped in batches of 130, around one of the three new towns, Littoria, Sabaudia and Pontinia. An expert adviser is available. The cost of the scheme is estimated at 7,000–25,000 lire per hectare; the purchase money therefore amounts to annual payments for fifteen years of sums varying from 200 to 630 lire per hectare, in addition to an annual payment of 70 lire per hectare as cost of upkeep and amortisation of the drainage works. These repayments, however, do not cover the Government contribution, but only that made by the concessionaires. No mention is made as to how the Government share is to be recouped. There is a similar, but somewhat smaller, reclamation scheme

in the lower Piave region running towards the Adriatic, and others on the Brisighella in the Lower Apennines, the Sele Plain, the Tirso, etc. The book ends appropriately with some long extracts from Mussolini's speeches on various important occasions in connexion with reclamations.

Señor Longobardi's book gives the best account at present available of Mussolini's remarkable achievements in land-reclamation. They are a challenge to other countries, and in reading about them, and still more in going over them, one is repeatedly asking whether such rapid improvements would be possible under the milder methods of western Europe.

E. J. RUSSELL.

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# Determinism and Man

**The Freedom of Man**

By Arthur H. Compton. (The Terry Lectures.) Pp. xii+153. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1935.) 9*s*. net.

SCIENTIFIC writers who have turned to the philosophical interpretation of science are invariably concerned with the relation between man and the physical and biological science he creates. These writers fall, roughly speaking, into three schools.

The first maintains that the methods that man has evolved for the study of the physical universe can be applied, without fundamental modification, to the study of mankind, and of man as an individual; that the determinism of physical science must apply equally to characteristics of the individual, and that from this can be deduced the behaviour of the mass. The universe, including man, is a complex machine. These are mechanists.

The second school sets man and his mind apart from the rest of the universe, asserts that although he is amenable to physical laws, these do not determine the whole of his actions, and that otherwise he is 'free' to act as he wills, in accordance with or against his moral conscience. There is a great variety of such philosophical idealists, ranging from the solipsist who maintains that the universe is created out of the elements of his (the particular solipsist's) consciousness, to those who believe that man, in the exercise of his will, is working out the law of a Superior Intelligence that exists outside man.

The third class asserts that man is a product of material nature, consciousness being a complex quality of the brain; that physical science has been produced by man in his struggle with the material world; that the scientific laws he finds operative to inanimate matter are not necessarily valid as they stand for the more complex problem arising when man, the active agent, is involved, the wider problem of 'man performing the social activity science', for example; but that this, being on a different level of complexity and abstraction, will exhibit laws of a specific nature which have themselves to be the subject of study. This class composes materialists who are not mechanists.

Prof. Compton, in the lectures before us, shows himself to belong to the second school. By a scrupulously careful analysis, frequently hesitating to commit himself, he strives to bring out the relation between his scientific and his religious thinking; in the former, standing fast by strict verifiable evidence, in the latter, supplementing the numerous lacunæ in evidence with general argument based on human and emotional needs. It is clear that there is a vital distinction in criteria between the two modes of thinking, of which Prof. Compton is not too conscious. In this way, he deals with the much discussed question of determinism, with the basis of his belief in a Superhuman Intelligence that guides the destiny of the universe, and with immortality. He concludes that there is a psychic element in the universe standing outside matter and surviving it, an element that, operating along with material indeterminacy, directs the course of human action. It is in fact an assertion of extra-material psychic determinism; and yet, alongside this, he seeks, rather inconsistently it seems, to retain freedom of action for the individual.

The case is well and interestingly argued throughout, but, as with other writings of this nature, the author assumes that in countering the case of the mechanists, he is destroying the materialist point of view. He seems unable to distinguish between the position adopted by the Encyclopædists, the mechanists of the eighteenth century, and that of the modern materialist. Had he done so, he would have recognised that there are in reality several distinct problems of determinism; but if they are to be dealt with as one, then the different levels that fall within its scope must be made clear. There is the sub-atomic level, the mass-particle level, and the human and the social level. To equate concepts at different levels is to miss the essence of scientific abstraction.

Scientific experimentation at the particle level is intrinsically deterministic, and is associated

with a particular type of prediction. The language of science, and therefore the language of scientific explanation, formulated at this level, tends naturally to be carried downward and upward in common speech to the sub-atomic and to the social levels. Immediately contradictions seem to emerge. When we talk of human or of sub-atomic determinism, are we talking about something that has a verifiable meaning of the same order as particle-determinism ? What is to be meant by prediction in each of these cases ? When we talk of 'freedom', how is it to be defined, or how are we to recognise it within each of the three categories ? These are questions we must pose and answer before we can be certain that we are using words sensibly or asking sensible questions when we inquire : "Has determinism broken down in the sub-atomic field ? Are we therefore 'free' human agents ?"

The idea that there is a breakdown in detailed prediction does not disturb the materialist, as many imagine, although it has excited the idealists into thinking that they see an escape from the imaginary moral strangulation of a rigid mechanistic determinism. Determinism at the sub-atomic level with its associated 'probability prediction' is a very different story from that at the social level, where the fact that man may frequently predict his own behaviour is a crucial quality of the situation. Prof. Compton, in common with many other outstanding physicists, ought surely to see this, for the nature of the material handled and the appropriate experimental methods are fundamentally different. Conscious living matter has qualities of a totally different order from those either of a particle or a photon. It is an active agent that can think, analyse and experiment. In the problem of 'man performing the social activity science', for example, man ranks as one of the determining forces in the situation. If we are to answer the question : "Is human action predictable ?" we have first to form the appropriate abstractions and devise an experimental technique, in order to create a basis for prediction at that level for this human process, to elucidate the laws exhibited. If man's actions are sometimes accompanied by a subjective sense of free-will, as they undoubtedly are, we have to discover the laws of free-will behaviour. All social predictions (and there are many of the small scale in the commercial and industrial world) are based on such laws. Their distinctive quality is that human beings as active agents form these laws and formulate them. As conscious beings, however, they can become aware of the laws they can make and therefore they can plan their future. That is the link between science and human progress.

When viewed from this angle, 'freedom of man', the subject of these lectures, is not something already existing or to be argued into existence. It is something to be achieved. To rank it with determinism at other levels is to miss its essentially distinctive character.

H. LEVY.

# Structure of Metals and Alloys

**The Structure of Metals and Alloys**
By Dr. William Hume-Rothery. (Monograph and Report Series No. 1.) Pp. 120+4 plates. (London : Institute of Metals, 1936.) 3*s*. 6*d*. net.

OF all the recent developments in metallography, the most outstanding has been that which has resulted from the invasion of the physicist and the physical chemist, both of whom have, in the past few years, applied their own methods of investigation more and more to the metals and their alloys. As a result, although most of the ideas reached by the use of the older methods have withstood this attack, other conceptions have had to be modified, and in one or two cases, drastically.

The most recent adventure of the Institute of Metals in publishing a series of monographs, each of which is to deal authoritatively with some special aspect of metallurgical interest, could not, therefore, have commenced with a more suitable one than that under consideration, nor could a more proper author have been selected than Dr. Hume-Rothery, whose own contributions to this particular field of study are well-known. The position of metallography at the common boundaries of so many sciences renders it almost impossible for its workers to maintain contact with all the developments which have a potential bearing upon their own lines of work, and the Institute of Metals and Dr. Hume-Rothery have performed a service to the science of metals which cannot be acknowledged in terms too high.

Assuming merely that knowledge of modern physics and physical chemistry which may now reasonably be expected from the metallographer, the author has, in a manner as simple as the nature of his subject permits, described present-day conceptions of the electronic structure of the atom, the crystalline structure of the elements and their atomic radii, the solid solutions which form

the end phases of the equilibrium diagrams and the phases which occur in between. The concluding section of the book is concerned with the imperfections of crystals, a matter of supreme importance to the metallurgist, whose materials are all aggregates of crystals, which in normal circumstance are very far from perfect. It cannot be too strongly stressed, however, that the work is essentially scholarly, and although necessarily written with the needs of the metallographer chiefly in mind, contains matter of the most direct importance to the physicist, the physical chemist and the crystallographer. For many readers the general account given will probably be adequate, but for those who desire to study the subject matter of this monograph still further, the long lists of references to original work will be of first-rate value.

It is inevitable that almost every metallographer will find certain aspects of the work with which complete acquiescence is impossible—to the present writer, for example, there appears to be an inadequate appreciation of the solidity of the structure built up on the basis of what may perhaps be termed classical methods—but there can be no doubt that the author has performed the task assigned to him in a most praiseworthy fashion. Both to him and to the Institute of Metals most sincere congratulations must be offered for the publication, at a price within the reach of all, and at a time when it is perhaps most needed, of a really authoritative account of pioneer work which may well initiate an entirely new era in fundamental, theoretical metallography.

F. C. T.

# Alpine Studies

**The Structure of the Alps**

By Prof. Léon W. Collet. Second edition. Pp. xvi + 304 + 12 plates. (London: Edward Arnold and Co., 1935.) 20*s*. net.

IN a review of the first edition of Prof. Collet's fascinating account of the building of the Alps (NATURE, 121, 412; 1928), the appeal of his work to mountaineers and holiday-seekers, as well as geologists, was emphasised. That the book should have gone out of print and a revised edition be required is a tribute to its value and interest; also to the rapid progress of Alpine studies. Indeed, as the author states in his preface to this second edition, "a brilliant international gathering of geologists has been engaged in following the Alpine structure in the Western, as well as in the Eastern, Mediterranean regions, and new ideas of the structure of the Alpine Range have been presented". Prof. Collet has therefore added a new Part 6, consisting of six short chapters dealing with the Apennines, the mountain-arcs of Corsica, Sardinia and Elba, the Alpine Chain of southern Spain and the Balearic Islands. As many of these areas are becoming increasingly popular as tourist resorts (and for residence), Prof. Collet's descriptions of the rock-structures and their effects on the scenery will be highly appreciated.

The increase in length of the book thus necessitated has been to some extent offset by a reduction of detail in some of the chapters, such as that on the Jura Mountains. In this regard, the author's policy will doubtless be welcomed by the non-technical reader, especially as opportunity has been taken to clarify parts of the text of other chapters, to add new diagrams, and to rewrite the chapters on Mont Blanc and the Aiguilles Ranges (to the knowledge of which Prof. Collet has himself made noteworthy contributions).

Some of the minor blemishes of the first edition have been removed. Students are no longer told (without supporting evidence) that the higher Pre-Alps represent a small part of Africa resting on Europe. Indeed, the new edition of the book conveys the impression of being less extremist in the matter of belief in the long-distance travel of overthrust sheets (*nappes*) of the earth's crust. An approach to the more moderate views of the Austrian geologists is shown by the attribution of the East Alpine sheets to Kober's *Zwischengebirge* (or *Zwischenmassiv*). It is perhaps unfortunate that the author introduces the inelegant term "Betwixt Mountains" for these masses; for, although it is a literal translation of one of Kober's expressions, the areas involved are not always mountainous (as witness, the country within the Carpathian arcs). A better English equivalent, "median mass", has been in use for some years. It is a pity also that the termination *-ides* has been retained in such words as Metamorphides, Dinarides (*G. Dinariden*). Astronomers do not write "Leonides", or cause confusion by trying to pronounce the word!

But, whether or not we agree about these matters of detail, or about the views of the extremists of the Nappe theory school, Prof. Collet's volume is unquestionably of great value.

P. G. H. B.

**Phenomena in High-Frequency Systems**

By August Hund. (International Series in Physics.) Pp. xv+642. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36s.

THIS well-packed book of specialised information does not appreciably overlap the author's previous "High-frequency Measurements", and is intended to give a comprehensive and up-to-date discussion of the rapidly varying phenomena which the electrical communication engineer controls for useful ends, possibly often without understanding entirely the basic physical principles.

The thermionics of gaseous and vacuous valves introduces the subject matter, after a prefatory acknowledgment of the pioneer observers and developers of electromagnetic theory and electronics; generators of high-frequency power, modulators, demodulators, rectifiers and amplifiers receive detail treatment, and electro-striction is made an important division of the main subject; the serious aspects of electromagnetic theory then find a place, with applications to the more practical phenomena associated with propagation through ionized space and the technique adopted in directing radiated energy.

There are useful appendixes, but the last chapter on filters seems incomplete and redundant in view of the more comprehensive treatises now being issued. The author has a critical sense of the work of others, and his 'display' diagrams are specially helpful for the elucidation of the operation of complex valves and antennæ systems; the reviewer has still to find an explanation of what happens at the corners when a long wire is folded up to form a directive antenna.

L. E. C. H.

**Die *Allotropie der chemischen Elemente und die* Ergebnisse der Röntgenographie**

Von M. C. Neuburger. (Sammlung chemischer und chemisch-technischer Vorträge, herausgegeben von Prof. Dr. R. Pummerer, Neue Folge, Heft 30.) Pp. 106. (Stuttgart: Ferdinand Enke, 1936.) 9.30 gold marks.

THE author gives an account of all the elements which have been supposed to exist in allotropic modifications and, by taking account of the latest methods of investigation, particularly X-rays, he decides which of them actually exhibit allotropy. The crystal forms of the allotropes are specified quantitatively, with very complete references to literature and diagrams.

Although the text is commendably brief and clear, it fails in one or two cases to supply information which the reader would like to have, such for example as to whether explosive antimony is an allotropic form or not. The author, in fact, is concerned almost entirely with the results of X-ray analysis, and where this is not applicable he tends to remain silent. In its field, the book is of very considerable value and serves as a reliable guide through a large mass of data, much of it contradictory. It states clearly in which cases allotropy has been established and where it has not, and in the doubtful cases it presents the evidence in an unprejudiced way.

**Soils:**

their Origin, Constitution and Classification; an Introduction to Pedology. By Prof. G. W. Robinson. Second edition. Pp. xvii+442+5 plates. (London: Thomas Murby and Co., 1936.) 20s. net.

PROF. ROBINSON'S novel treatment of soil science evidently 'met a long-felt want', for a new edition has been required in less than four years. The rapidly developing subject of pedology has many more intimate links with other branches of science than had the older agricultural chemical treatment of soils. At the same time, it bears more closely on those general questions of land classification and utilisation which are becoming increasingly urgent. Surveys and planning must be preceded by careful study of the objects to be classified and their relationships to environmental and historical factors. Prof. Robinson's book shows how far the modern science of soils has been able to go in the interpretation of the formation and behaviour of soils. The geographical and genetic aspects are kept in the foreground throughout, while the more purely technical and agricultural ones are treated very briefly indeed. The book can be strongly recommended to workers in many branches of natural and applied science.

In the new edition the bibliography has been increased and the illustrations greatly improved. Quite recent work on the clay complex, base exchange and soil moisture are fully discussed, space having been gained by omitting the appendix on methods of analysis, which were well handled in Mr. C. H. Wright's recent book.

**Official Year Book of the Commonwealth of Australia**

No. 28, 1935. Prepared by E. T. McPhee. Pp. xxxi+971. (Commonwealth Bureau of Census and Statistics, Canberra.) (Canberra: Commonwealth Government Printer, 1936.) 5s.

THE new issue of this valuable year book is planned on the usual lines, and even if the call for economy still curtails the size of the volume and curbs the desire of the editor in the presentation of available data, the scope is so comprehensive that little of real importance can have been omitted.

After a summary of the history of the Commonwealth, with the Act of Constitution in full, there follows a chapter on the climate and meteorology provided with statistics, graphs and a rainfall map. Among the many chapters of administrative and financial statistical detail, there is especially full treatment of vital statistics as disclosed in the census of 1933. It appears that the birth-rate in Australia has fallen to the relatively low figure of 16·4 per 1,000 from 27·1 in 1901. If this is low, the death-rate of 9·3 per 1,000 is one of the lowest in the world, so that the natural increase is still higher than in European States excluding Russia, the Netherlands, Spain and Italy. Increase by immigration, which was so high as 32,000 in 1927, fell to about 1,000 in 1934 after four years of actual loss by emigration. The volume has full particulars of agricultural production and mineral output. New Guinea is included in the survey. There is a useful bibliography.

# Canadian Water Power Developments during 1935

By Dr. Brysson Cunningham

THE series of reports[1] recently issued by the Dominion Water Power and Hydrometric Bureau indicate that, during the year 1935, there was steady progress in the development of water power in Canada, resulting in a substantial addition to the aggregate power installation, which on December 31 last reached a total of 7,909,115 horse power, as compared with 7,547,035 horse power at the close of the preceding year. The accompanying table shows the distribution of power among the provinces of the Dominion. It is pointed out that while the increase in generating capacity is noteworthy, there is even greater significance in the continued growth of the demand for power, as reflected in the monthly records compiled by the Dominion Bureau of Statistics, which indicate a steady increase, month by month, over the figures for the previous year, amounting in general to more than 11 per cent. This increase, it is stated, is not confined to any one part of the Dominion but extends from the Atlantic to the Pacific.

Available and Developed Water Power in Canada, January 1, 1936.

| Province | Available 24-hour power at 80 per cent efficiency | | Turbine installation (h.p.) |
|---|---|---|---|
| | At ordinary min. flow (h.p.) | At ordinary six months flow (h.p.) | |
| British Columbia | 1,931,000 | 5,103,500 | 718,497 |
| Alberta | 390,000 | 1,049,500 | 71,597 |
| Saskatchewan | 542,000 | 1,082,000 | 42,035 |
| Manitoba | 3,309,000 | 5,344,500 | 392,825 |
| Ontario | 5,330,000 | 6,940,000 | 2,560,155 |
| Quebec | 8,459,000 | 13,064,000 | 3,853,820 |
| New Brunswick | 68,600 | 169,100 | 133,681 |
| Nova Scotia | 20,800 | 128,300 | 116,367 |
| Prince Edward Island | 3,000 | 5,300 | 2,439 |
| Yukon and Northwest Territory | 294,000 | 731,000 | 18,199 |
| Total | 20,347,400 | 33,617,200 | 7,909,115 |

Among the chief installations inaugurated in 1935 were three additional units of 66,000 horse power each at the Canyon station of the Ontario Government on the Abitibi River, bringing the station up to its full capacity, as designed, of 330,000 horse power, and the addition of two 50,000 horse power units at Beauharnois, on the St. Lawrence River, by the Beauharnois Light, Heat and Power Company, bringing the number of units at that station up to eight, with an aggregate capacity of 400,000 horse power. This latter installation, which has been already described in NATURE[2], comprises very important control works on the St. Lawrence River, with the diversion of an authorised quantity of 53,072 cu. ft. per second from the river flow. These control works have now been completed. The MacLaren-Quebec Power Company has added a fourth 30,000 horse power unit to the High Falls installation on the Lièvre River, bringing it up to its total ultimate capacity of 120,000 horse power.

It is, accordingly, evident that the activities of the various companies and authorities engaged in hydro-electric exploitation continue unabated, but there is still ample scope for further development, since it is reliably estimated that Canada has an aggregate available water power totalling 20,347,400 horse power under conditions of ordinary minimum flow, and 33,617,200 horse power ordinarily available for six months of the year. Even these figures are probably understatements, for on the basis of the actual waterwheel installation throughout the Dominion, there is a realised excess of 30 per cent over the calculated quantities, so that it may confidently be stated that the actually recorded resources of the Dominion admit of a turbine installation of some 44,700,000 horse power, of which only about 18 per cent has so far materialised. Yet, even this relatively small percentage places Canada with its 722 horse power per 1,000 inhabitants in an outstanding position amongst the water power using countries of the world. The provinces of Ontario and Quebec jointly possess more than 81 per cent of the total developed power, representing, in Quebec, a proportion of 1,258 horse power per 1,000 inhabitants, and in Ontario, 712 horse power per thousand.

It is interesting to note the uses to which the power is put. Almost 88 per cent of the total hydraulic development is utilised in central electric stations, and represents more than 95 per cent of the main generating equipment of the industry which, in turn, generates more than 98 per cent of the total electricity produced for sale in Canada and for export. Although not specially remarkable in size or power, the view in Fig. 1 is interesting as an example of a recent development at Sault Ste. Marie, on the St. Mary River, Ontario. The installation is of 28,050 horse power

and belongs to the Great Lakes Power Company. Another channel of absorption is the pulp and paper industry, Canada's predominant manufacturing activity, which has hydraulic installations of 605,346 horse power and a motor installation for operation by hydro-electricity aggregating more than 1,029,000 horse power, or a combined mechanical installation of more than 1,634,000 horse power. In addition, the industry purchases large quantities of electricity from the central electric stations for use in electric boilers. Fig. 2 shows a development of 56,250 horse power at Smoky Falls on the Mattagami River, belonging to the Spruce Falls Power and Paper Company Ltd.

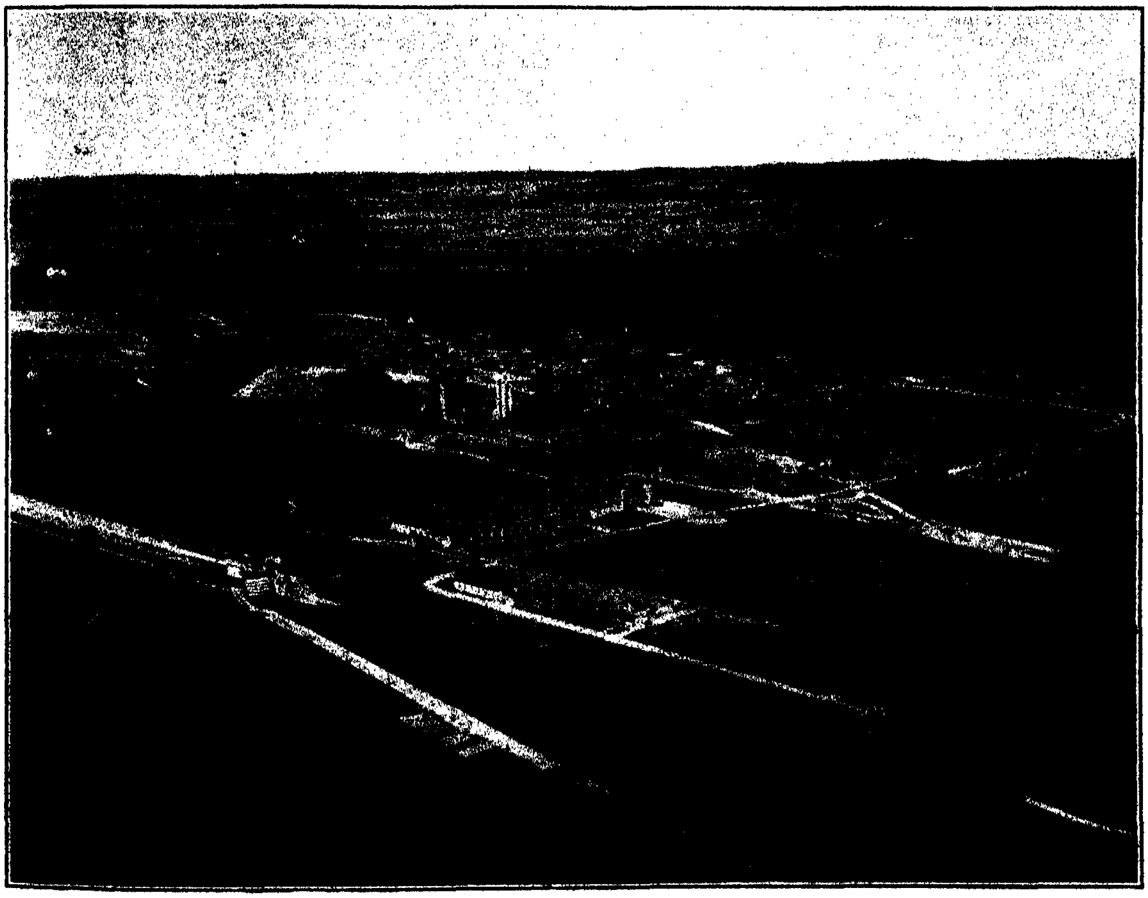

FIG. 1. Sault Ste. Marie development, St. Mary River, Ontario. 28,050 horse power. Great Lakes Power Co., Ltd. By courtesy of the Canadian Official News Bureau, London.

Water power is also a valuable aid to the mineral industries, and indeed its importance in this respect can scarcely be overstated. The convenient location of ample supplies of hydraulic power economically adjacent to mineral fields and centres of mining activities, and the consequent low price generation of power have been dominant factors in the successful development of the mining industry in Canada. A particularly notable feature is the large volume of lower grade ore which can be, and is, profitably mined as a result of the low cost of power. In the latest Annual Report issued by the Dominion Bureau of Statistics on the mineral production of Canada, it can be seen that the Dominion produces, normally, about 90 per cent of the world's supply of nickel, 60 per cent of its asbestos, nearly 35 per cent of its cobalt, 12 per cent of its gold and lead, 10 per cent of its silver, 15 per cent of its zinc and 13 per cent of its copper, besides being one of the major producers of the platinum metals and of aluminium, radium and uranium. Moreover, there is a wide field among the rocks of the great Laurentian Plateau or Pre-Cambrian Shield for the further exploitation of mineral deposits, remarkable alike as regards variety and extent, and this area contains nearly 60 per cent of Canada's available water power, an endowment which is highly favourable to economic development. The Report of the Water Power Bureau affirms that "so far as information is available, there is no present or

prospective mineral area, with the exception of some of the coal fields of the middle plains, where hydraulic energy cannot be made available as demand arises".

One of the most enterprising administrative organisations of the Dominion is the Quebec Streams Commission, which continues to maintain efficiently the desired regulation of flow on all the controlled rivers by means of its extensive system of storage reservoirs in various parts of the province. The Commission now controls seventeen reservoirs, some of them of very considerable size. During the year under review, important legislation was passed by the Quebec Provincial Government extending the powers and activities of the Commission to the actual development and utilization of water power sites, the operation of hydro-electric installations and the production and transmission of hydro-electric energy, as also its purchase from other central electric stations and its re-sale to municipalities and other consumers. A new Commission, the Quebec Electricity Commission, has been created with wide powers in regard to the regulation of operations, and the levying of rates and other matters connected with the production and distribution of electrical energy in the Province.

With these evidences of the energetic exploitation of its resources of water power, so realistically described in French as *la houille blanche* (white coal), it can be seen that Canada is more than counterbalancing its deficiency in natural fuel. At a moderate estimate of equivalence, the present hydro-electric installations, on the record of their output for 1935, are shown capable of effecting a saving in coal of 19 million tons per annum, and since owing to the lack of geological coal deposits, the highly industrialised Provinces of Ontario and Quebec are under the necessity of importing supplies, it is obvious that the substitutionary power is of the highest importance to their commercial welfare.

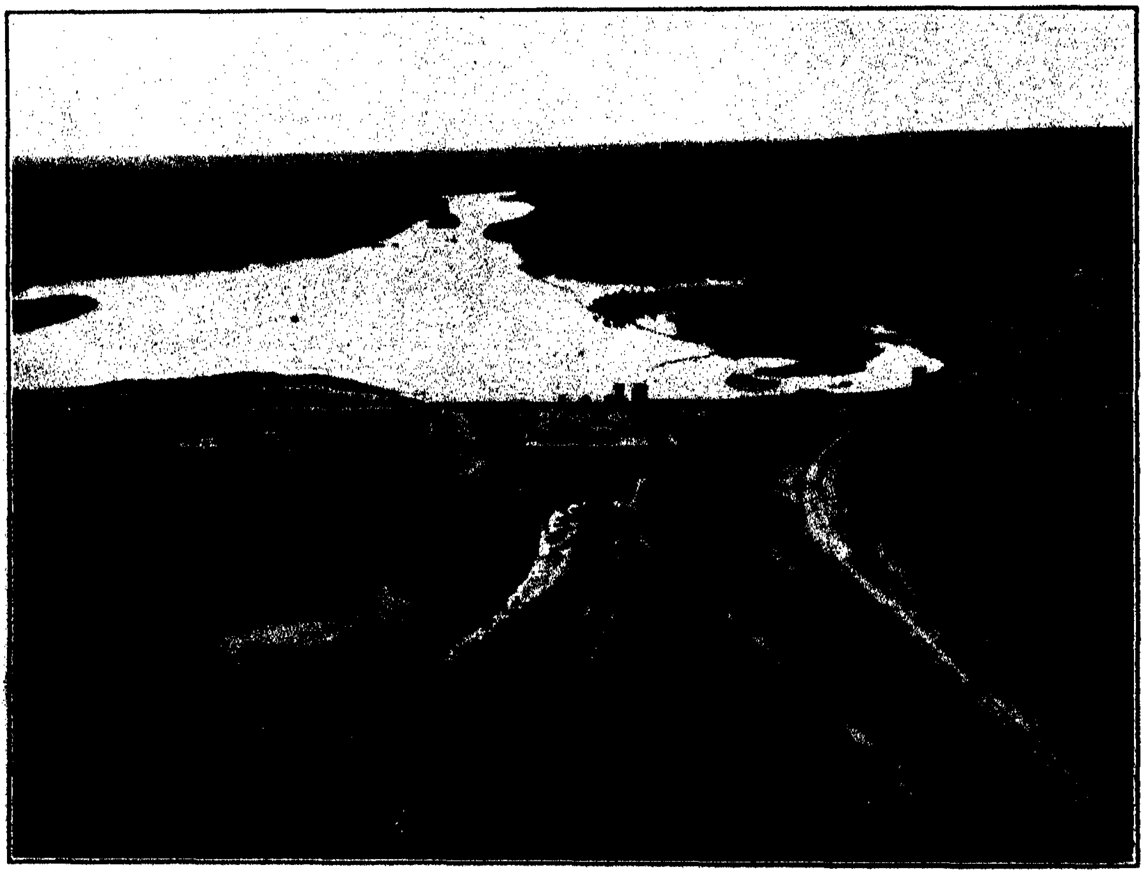

FIG. 2. Smoky Falls development, Mattagami River, Ontario. 56,250 horse power. Spruce Falls Power and Paper Co., Ltd.
By courtesy of the Canadian Official News Bureau, London.

[1] Hydro-electric Progress in Canada in 1935. Paper No. 1871. Water Power Resources of Canada, and Hydro-electric Progress in 1935: A Review of the Year's Activities. By the Hon. T. A. Crerar, Minister of the Interior. Paper No. 1879. (Ottawa: Dominion Water Power and Hydrometric Bureau, 1936.)

[2] NATURE, 131, 788 (1933).

# Indeterminism and Free Will

By Prof. E. Schrödinger

IT has become the orthodox view of physicists to-day, that the momentary state of a physical system does not determine its movement or development or behaviour, to follow ; Nature is supposed to be such that a knowledge of state, sufficiently accurate for sharp prediction of the future, is not only unobtainable but also unthinkable. All that can be predicted refers to a large number of identical experiments, and consists in a definite statistics among all the possible developments to follow. The relative margin of indeterminacy (the 'spread' of the statistics) is large for a small system, for example, for an atom ; but for large systems the margin is usually, though not necessarily, small, which makes it possible to account for the *apparent* determinacy of inanimate Nature.

Many eminent scientific workers, especially physicists, have tried to play with the idea that the *apparent indeterminacy* of animate Nature, that is, of living matter, might be connected with the theoretical indeterminacy of modern physics. What makes this play so fascinating and thrilling is evidently the hope (whether outspoken or concealed) of extracting from the *new* physical dogma a *model of free-will*, which the *old one* would refuse to yield. I consider this hope an illusion, for the following general reasons.

When observed objectively in other creatures, free-will actions do not call for a special 'indeterminist' explanation any more than other events. When two persons (or the same person on different occasions) react differently under apparently the same conditions, we feel compelled to account for it, whether the reaction is a passive or an active one, by a real, though unknown, difference of conditions, including, of course, character and temporary disposition on the part of the reacting persons. A poet unrolling before us the objective picture of free-will actions is just as concerned about proper causation (here called motivation) as the classical physicist was for inanimate Nature.

On the other hand, when regarded as a fact of self-observation, free-will has quite a different standing from scientific experience. The two are, as it were, in different planes, which do not intersect. Self-observed free-will I would analyse into *two* facts. First, indeed, a prediction, but *not* based on previous experience, certainly not in the way in which scientific prediction is. If I am the actor, I just *know* what is going to happen, and that, apart from pathological cases, with the greatest amount of certainty which is ever met with in life. The *second* fact is a moral one : I feel responsible for what happens.

Now, it is true that this *absolute* prescience is a matter only of the very last moment before or when the action sets in, which it rather accompanies than precedes. Before that there is frequently doubt and even entire ignorance ('hesitation'). This antecedent period, together with the remarkable feeling of responsibility, entails the idea of *choice* between different possibilities for which a clue is sought in the modern views of physics. If that were right, it would mean *either* one of two things. First, that the laws of Nature are after all at "my" mercy. For if my smoking or not smoking a cigarette before breakfast (a very wicked thing !) were a matter of Heisenberg's uncertainty principle, the latter would stipulate between the two events a definite statistics, say 30 : 70 ; which I could invalidate by firmness. *Or*, secondly, if that is denied, why on earth do I feel responsible for what I do, since the frequency of my sinning is determined by Heisenberg's principle ? The new physics does not shift St. Augustin's paradox by a hair's breadth.

In my opinion the whole analogy is fallacious, because the plurality of possible events, in the case of an action under free-will, is a self-deception. Think of cases such as the following : you are sitting at a formal dinner, with important persons, terribly boring. *Could* you, all at once, jump on the table and trample down the glasses and dishes, just for fun ? Perhaps you could : maybe you feel like it : at any rate you *cannot*. Then, which of the virtually possible events are to be called possible under the auspices of free-will ? I would say, just the one that actually follows.

Against this view cases might be quoted where the decision is really difficult, serious, painful, bewildering, when we are down on our knees before the Almighty to forgo it. But in this He is inexorable ! We *must* decide. One thing *must* happen, *will* happen, life goes on. There is no $\psi$-function in life. I have always considered this having-to-decide as a strikingly close subjective correlate to the classical, the deterministic model of Nature. It ought to be emphasized that modern physics does not compel us to abandon this correlation. The material units which determine the

processes of life seem to be large enough for—possibly and even probably—safeguarding the essential course of these processes against any perceptible direct and immediate manifestation of the Heisenberg uncertainty.

The preceding remarks have been elicited by the first page of a highly interesting sketch by Prof. F. G. Donnan, "Integral Analysis and the Phenomena of Life" (Acta Biotheoretica, Series A, vol. 2, Pars 1, 1936 ; Leyden : E. J. Brill), though not by way of contradiction. Prof. Donnan is not concerned with the question of free-will. His idea is that an organism is to be regarded as a 'historical' system, whose reactions at a given moment are not determined alone by its surroundings and by its momentary state, but also by what has happened to that organism during a certain previous period. This is a highly attractive view, and the mathematical treatment proposed by Prof. Donnan a very suggestive one—even if one should hesitate to agree with the view (which he considers essential) that some of the historical traces are *not* engraved in the momentary state otherwise than by modifying its reactivity.

# The Institute of Experimental Psychology at Oxford

THE University of Oxford has recently enacted a statute establishing an Institute of Experimental Psychology, at which active work will be begun in the autumn. Dr. William Brown, Wilde reader in mental philosophy in the University, has been appointed its first director, with Dr. William Stephenson as his assistant. The management of the Institute is in the hands of a committee consisting of the Vice-Chancellor, a representative appointed by each of the boards of the Faculties of Medicine, *Literæ Humaniores*, Biological Sciences and Social Studies, together with the director.

Thus Oxford has at length officially fallen into step with the movement that has been going on for more than fifty years, the aim of which has been to free psychology from the exclusive tutelage of philosophy, and establish it as an independent, empirical and experimental science. Such freedom, however, does not imply separation, nor can the independence be more than a relative one.

In taking its place among the other natural sciences, the data of all of which provide grist for the philosophical mill, psychology will still look to philosophy, as they do, for the solution of some of the ultimate problems ; though it will pursue its own proximate quests by its own empirical line of approach and the use of its own appropriate methods. Grouped together with the other sciences, again, and particularly with the biological and social sciences, there will be much overlapping and interlacing, which can only result in great mutual advantage to them all. Both these points have most wisely been taken into consideration in the constitution of the committee of management of the new Institute.

The foundation of this laboratory at Oxford is in a sense a historic event. For centuries, the University has been the home of philosophy, of which psychology has always been an integral and essential part. In the Middle Ages, Roger Bacon and Duns Scotus, no mean psychologists, stand out amongst its scholars. In the seventeenth century, the 'father' of modern psychology, John Locke, author of the famous "Essay Concerning Human Understanding", was a student of Christ Church. When the Wilde readership was founded in 1898, a distinguished psychologist, G. F. Stout, was appointed to hold it ; and he was succeeded by a no less distinguished teacher of the science than William McDougall.

An age-long tradition was there ; the conversion of rational into empirical psychology had already begun. But as yet there was no established laboratory in which systematic research could be prosecuted. One is tempted to ask why Oxford should have lagged behind when Cambridge, London, Manchester, Edinburgh forged ahead, in company with most other European and American universities, following the lead of Wundt at Leipzig. Was it opposition from the ancient vested interests of philosophy ? Was it the belief that scientific psychology was a mere appendage of physiology ? Did the terms of the Wilde readership, excluding experimental psychology explicitly from its purview, stand in the way ? Of recent years, at any rate, it was none of these things. Before the Great War, McDougall was able for a time to direct a laboratory, housed in rooms belonging to the Department of Physiology, and having access to apparatus in use there. Solid work had already begun ; and, but for the upheaval of the War years and their aftermath, it might have become permanent. But the accommodation was then urgently needed for other purposes, and funds were unavailable ; so the project had to be abandoned.

During Brown's fifteen years' tenure of the Wilde readership, several attempts were again made in this direction; but, though encouraged by much friendly sympathy on the part of the authorities, the same lack of funds and rooms in which to house a laboratory made it impracticable. Last year, however, a generous offer of £10,000 was made through the Wilde reader for this purpose; and it was gladly accepted by the University. The curators of the University Chest will provide the necessary accommodation; and a further sum of £500, together with a grant of £150 a year for five years from the Rockefeller benefaction for research in the social sciences, is to go to the Institute.

# Centenary of Darwin's Visit to the Galapagos Islands

## Issue of Commemorative Stamps by Ecuador

DISTINGUISHED men of science have, before now, been commemorated on postage stamps by countries sufficiently civilized to value their achievements, but it does not appear that any particular event in the history of science has hitherto been celebrated in this way. It has been left to the Republic of Ecuador to mark, by the issue of a special series of stamps, the centenary of a critical point in the development of the evolution theory. It was on September 16, 1835, that Darwin first landed on Chatham Island in the Galapagos group, where, as he wrote in his "Journal of Researches", "we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth". The influence of what he saw there on the later development of his thought is now a commonplace of biological teaching, although some modern writers on evolution might be well advised to read again his own account of his observations and the conclusions to which he was led.

FIG. 1. Stamps issued by the Ecuadorean Government in commemoration of the centenary of Darwin's visit to the Galapagos Islands in the *Beagle* in 1835.

The six stamps which are here reproduced bear designs associated with the islands or with Darwin's visit, the introduction of a portrait of Christopher Columbus being apparently suggested by the Ecuadorean name for the group, "Archipelago of Colon". The portrait of Darwin is taken from a well-known photograph now hanging in Down House; it represents him in his old age, and is probably that by which he is best remembered, although at the time of his visit to the Galapagos Islands he was, of course, a young man of twenty-six years. A view, presumably representing some place in the islands, has a group of coconut palms in the foreground. If this is correct, it indicates a change in the flora since Darwin's time, for he notes in his "Journal", "I saw nowhere any member of the palm family". Two of the designs represent reptiles characteristic of the islands, one of the land iguanas and one of the giant tortoises from which the group takes its name. How many zoologists, one wonders, associate "Galapagos" with the familiar but etymologically obscure word "carapace"?

It is important to remember that one of the things that struck Darwin on visiting the islands was the abundance of individuals, especially of some of the larger reptiles. This density of

population has now become a thing of the past, and the accounts of recent travellers make it clear that unless adequate protection can be given, the disappearance of this unique fauna is only a matter of time. *It is therefore a subject* for congratulation that the Ecuadorean Government has taken an enlightened view of its responsibilities. It has declared the greater part of the archipelago a Nature reserve, in which no hunting or collecting is allowed except by special permission for scientific purposes. Further, a list has been drawn up of the species more immediately threatened, and the killing or capture of these is prohibited, except that the inhabitants may kill some of them for food.

Many scientific bodies on both sides of the Atlantic have expressed their approval of the steps taken, and have offered to co-operate in rendering them effective. A committee of the British Association, under the chairmanship of Sir Edward Poulton, is at present considering what can be done to organise this international co-operation with the Ecuadorean Government.

W. T. CALMAN.

# Obituary

## Prof. A. A. Bowman

BY the death on June 12 of Prof. A. A. Bowman at his home in Glasgow, British philosophy has lost one of its most effective and attractive personalities.

Prof. Bowman was fifty-three years of age. Except for the period of the War, he had spent his life in the study and teaching of philosophy, first in Glasgow, then in the United States, finally again in Glasgow. He took his degree in classics and philosophy: and after a post-graduate year in Germany, he served his apprenticeship to teaching in Glasgow. In 1910 he was elected professor of logic at Princeton, New Jersey, becoming later administrative chairman of the Department of Philosophy. In 1926, at more than a little material sacrifice, he accepted a call to return to his old University. For one year he held the chair of logic: and from 1927 until his death the chair of moral philosophy. At no time in the long history of that illustrious chair has its holder exercised a stronger personal influence upon his students, upon the University as a whole, and upon Glasgow and the west of Scotland, than Bowman exercised during his short tenure.

Bowman was profoundly a man of peace, and ardent in service of its better organization. The War, however, especially the last months of it, was one of the decisive experiences of his life. He was in the United States. But from the beginning of the War he was restless. In 1915 Princeton gave him leave of absence. The British authorities in the United States, thinking him (quite rightly) medically unfit for active service, refused to recruit him. He came home at his own expense, found some complaisant medical officer to pass him for home service, then, being in the army, badgered his superiors until finally they let him go to France. After a few months campaigning, he was captured in the Lys break-through of April 1918 and sent to a prison camp. That, which seemed to be the end of his service, proved in fact to be his opportunity. Conditions in the camp were deplorable. Bowman's fluency in German made him the natural centre and unofficial leader of the camp. With tremendous resolution, he threw himself into the task first of *improving those conditions through negotiation* with the German authorities, and then of raising and maintaining the morale of his fellow prisoners. His main instrument for that purpose was a system of tutorial classes which had to be carried through without books or material or facilities of any kind; indeed, with almost no other resource than his own erudition and the persuasiveness of his teaching. He gave lectures and instruction in literature, in philosophy, in contemporary history (especially German and Russian), and in the history of art; and on groups of men quite unfamiliar with these themes, he made a profound impression. He taught them really to save their souls; and he was inspired in the task. That experience sharpened and developed his powers of leadership and of public speech. He had always been a good teacher; the prison camp made him one of the most brilliant and powerful expositors of his time.

Both in the United States and in Scotland Bowman had immense influence. Of slight and even frail physique, he had superb spiritual energy and insight, unshakeable courage, and, as has been noted, quite unusual powers of expression. Scholarship was natural to him: and although his flair was for speculation at once bold and thorough, it was always backed by solid learning. All his life he was an ardent student of classical and of modern literature. He had read widely in social theory and history. He was a good critic of painting. Especially in later years, his studies in the philosophy of religion had drawn him into the field of cultural anthropology, in which he had a vast and intimate knowledge of a great variety of primitive civilizations. All this equipment he brought into fullest play in the ordinary business of his crowded class-room. His students, indeed any audience which he addressed, fell instantly under his spell. For his learning, his humour and his eloquence were no more than the instruments of a man of richest personal quality—of deep insight, of rare imaginative power, and of profound moral and social convictions. In philosophy, he held by the Idealist tradition in which he had been nurtured. He gave it

a metaphysical form of his own which his early teachers would have found strange. But he never moved from their conception as to the nature and importance of the issues with which philosophy is concerned. In his hands philosophy was a way not only of thought but also of life. He had worked out his system in the grand style, compact, articulate, thorough and comprehensive, and he presented it with uncommon power.

Bowman's great work was done in the class-room and on the public platform. The tale of his publications is small: a volume of sonnets—the fruits of his prison camp experience—two or three pamphlets and a few articles in learned journals. Happily there is a bigger book almost ready for the press; and it may be hoped that in the large mass of manuscript material which he has left, enough will be found in readily publishable form to give to others than his own students, some idea of the reflections of one of the most original, interesting and courageous minds of our time.

H. J. W. HETHERINGTON.

## Prof. Margaret Benson

PROF. MARGARET BENSON, whose death on Saturday, June 20, is mourned by a wide circle of friends, is known best to botanists as one of the leading palæophytologists of the last generation. Much of her early work on fossils, which began about 1904, has long been incorporated into the text-books; but it is only a year since she published her last paper on the subject. Her best work was done at a time when the technique of fossil cutting was in its infancy, and for years she cut her own sections at a small lapidary bench in a shed in the grounds of the Royal Holloway College, with a cutting machine worked by a gas engine. She left her valuable collection of fossil slides to the College.

Prof. Benson's industry and single-mindedness were quite exceptional, and were combined with a very real flair for knowing what a fossil might yield and how a structure might be interpreted. She was trained in research at Newnham College, Cambridge, and University College, London, and her early work there on the embryology of Amentiferæ, for which the D.Sc. of the University of London was conferred on her in 1894, is now a classic. In October 1893 she was appointed head of the newly founded Department of Botany at the Royal Holloway College. The Department flourished under her, and in 1912 the University conferred on her the title of University professor of botany, which chair she held at the College until her resignation in 1922.

Prof. Benson was a great traveller and collector; and the botanical garden, museum, herbarium and well-stocked laboratories of her College to-day bear witness to her indefatigable enthusiasm and wise foresight. In the Michaelmas term of 1897 she was granted leave of absence in order to visit the professors of botany of Brussels, Heidelberg, Tübingen, Basle, Strasbourg and Paris in their respective laboratories during term. This tour she made with the view of securing the best information for the equipment of a botanical laboratory. In later years she made two journeys to the antipodes, and on both occasions brought back quantities of valuable specimens. Her botanical work is of enduring value, and she inspired many generations of students with a love of the subject.

E. M. B.

## Prof. A. A. Noyes

THE death of Arthur Amos Noyes, director of the Gates Chemical Laboratory at the California Institute of Technology, which occurred at Pasadena on June 3 as the result of an attack of pneumonia at the age of sixty-nine years, has deprived physical chemistry of another of its pioneers of the Ostwald school. Noyes may be regarded, indeed, as the American prototype of Sir James Walker, who died last year. Just as Walker was Ostwald's first British student at Leipzig, Noyes was the first American. Of them, Ostwald remarks in his autobiography: "Both are not only distinguished as investigators and teachers, but belong also as men to the best examples of this diversified race".

For nearly twenty years the research laboratory of physical chemistry of the Massachusetts Institute of Technology, which Noyes directed and to which he personally contributed half the expenses of maintenance, was the centre of this branch of science in the United States, and many of the leading American physical chemists may be counted among his students. His own contributions to the ionic theory of electrolytes and to the principles of qualitative analysis were of primary importance in the modern development of these two fields.

Modesty and thoroughness were the chief characteristics both of Noyes' work and of his character. He sought no honours: he leaves many friends.

JAMES KENDALL.

WE regret to announce the following deaths:

Mr. Arthur D. Carey, known for his explorations in Central Asia, for which he was awarded the Founder's Medal of the Royal Geographical Society in 1889, on June 11, aged ninety-one years.

Prof. Ira E. Cutler, emeritus professor of zoology in the University of Denver, on May 25, aged seventy-three years.

Prof. W. E. Dalby, F.R.S., emeritus professor of engineering in the City and Guilds College, Imperial College of Science and Technology, University of London, on June 26, aged seventy-two years.

Prof. Ivan Hönl, professor of bacteriology in the University of Prague, known for his work in combating the scourge of tuberculosis in Central Europe, on June 7, aged seventy years.

Mr. Frank Merricks, past-president of the Institution of Mining and Metallurgy, and a member of the Geological Survey Board in 1920–26, on June 8, aged seventy years.

Sir Charles Nathan, C.B.E., member of the Executive Council of the Australian Commonwealth Council for Scientific and Industrial Research in 1927–28, on June 5, aged seventy-six years.

# News and Views

## Retirement of Prof. W. A. Bone, F.R.S.

AT the end of the present session, Prof. W. A. Bone vacates, under the age limit, the chair of chemical technology at the Imperial College of Science, which he has held for the past twenty-five years. A graduate of Owens College, Manchester, he studied under Prof. H. B. Dixon and later, when lecturer there in chemistry and metallurgy, he carried out those classical investigations into the slow and explosive combustion of hydrocarbons which have done so much to elucidate the mechanism of their oxidation, and enabled him to formulate the hydroxylation theory. In 1905, he became the first Livesey professor of coal gas and fuel industries in the University of Leeds, and there laid the broad foundations of the new branch of science, fuel technology; there also, in collaboration with McCourt, he invented and developed surface combustion. At South Kensington, Prof. Bone was faced in 1912 with the task of building up a new Department of Chemical Technology, and under his inspiring leadership a research school of world-wide reputation has been created. His field has covered high-pressure explosions and gas reactions, flame spectra, the study by high-speed photography of flame movements in gaseous explosions, the chemical constitution of coal and gas reactions in the blast furnace. At a dinner on June 17, given in honour both of Prof. Bone and Mr. W. C. Hancock who is also retiring from the lecturing staff of the Department, a distinguished gathering including many old colleagues and students assembled, and suitable presentations were made. Fortunately Prof. Bone's retirement does not mean the ending of his scientific activities, for the College authorities, strongly supported by industry and other outside bodies, are providing a new research laboratory in which he will be enabled to pursue those investigations on which he is still actively engaged.

## Société de l'Industrie Minérale: Foreign Members

AT a general meeting of the Société de l'Industrie Minérale, St. Etienne, held on May 24, it was decided that the Society should, for the first time, elect honorary members, the terms of the modified statute being that "the title of Honorary Member can be given by the General Meeting to persons of foreign nationality who have promoted the mineral industry or the society by their works". The first elections under the new statute are: Sir Robert Hadfield; Dr. C. E. Guillaume, director of the International Bureau of Weights and Measures; Prof. L. Denoël, professor of mining in the University of Liège; and Prof. P. Fourmarier, professor of geology in the University of Liège. The Société de l'Industrie Minérale, which was founded in 1855, is one of the leading associations of French engineers, and has a roll of nearly two thousand members.

## Meyer Medal for Plant Introduction

THE Meyer Medal of the American Genetic Association, for distinguished service in plant introduction, was presented on June 13 to Mr. P. H. Dorsett, who for more than forty-five years has been associated with the scientific work of the U.S. Department of Agriculture. Mr. Dorsett was instrumental in bringing together the largest collection of soy bean varieties that has ever been made. Two expeditions to China were undertaken to make this collection. On the first trip Mr. Dorsett and his son, the late James Dorsett, collected more than two thousand samples from Nanking and its vicinity. On the second expedition, Mr. Dorsett and Dr. William J. Morse, soy bean expert of the U.S. Department of Agriculture, collected more than six thousand samples which were sent to the United States for test. A total of some two thousand distinct varieties of soy beans was obtained from these samples. These are being tested to determine their value to the American farmer. Some of them are already being widely used. The soy bean is a relatively new plant immigrant in the United States, but in 1935 five and a half million acres were planted with it, and forty million bushels of the dry beans were harvested. Mr. Dorsett also took part in three expeditions to obtain new varieties of plants to Brazil (1913–14) and to the West Indies in 1927–30. He was instrumental in bringing into the U.S. valuable citrus varieties and many rare ornamental plants. The Meyer Medal is awarded at intervals by the Council of the American Genetic Association for distinguished services in plant introduction. It is named in honour of the late Frank Meyer, pioneer plant explorer of the U.S. Department of Agriculture, and had its origin in a fund left by Meyer to his fellow workers in plant introduction, who decided to use it for this purpose. Meyer spent the last nine years of his life in plant explorations in China. Among previous recipients is Mr. H. N. Ridley, who was responsible for the introduction of Para rubber into the East Indies.

## Newton Manuscripts

AN interesting sale of manuscripts is advertised by Messrs. Sotheby and Co., 34 and 35 New Bond Street, on July 13 and the following day. Readers of NATURE may remember the "Portsmouth Papers", strictly a "Catalogue of the Portsmouth Collection of Books and Papers written by or belonging to Sir Isaac Newton", published by the Cambridge University Press in 1888. The then Earl of Portsmouth presented the scientific part of these papers to the University, and an influential syndicate of the University issued a catalogue of the whole, and took a copy of the more important letters that it did not keep, and returned these to Lord Portsmouth. The Portsmouth family, which has a connexion with

Newton, has put the manuscripts, or such as they have now, in the hands of all serious workers, from Horsley to L. T. More. Viscount Lymington, the heir of the Earl of Portsmouth, has now instructed Messrs. Sotheby to sell them. It might thus seem that there was little except personal matters to find. Many of the letters have been published, accurately or inaccurately, whole or in part, in various well-known sources. But the list includes, for example, such items as "three thick folio volumes", which we did not know of, relating to the Mint and containing documents in Newton's hand. It makes one leave in suspense the Cambridge report, that "Newton's manuscripts on Alchemy are of very little interest in themselves", probable as this may seem in itself, and though the syndicate contained one notable chemist. Also Messrs. Sotheby have added some celebrated portraits to their list. The sale should be well attended; for though most of the contents that are valuable are available, many would like a copy of Newton's beautiful handwriting and that of his contemporaries, apart from those that contemplate a more extensive purchase.

### National Inland Water Survey

THE first Annual Report of the Committee appointed in January, 1935, jointly by the Minister of Health and the Secretary of State for Scotland, "to advise on the Inland Water Survey for Great Britain, on the progress of the measures undertaken and on further measures required and, in particular, to make an annual report on the subject", has been awaited with keen anticipation in many quarters, and especially by those engaged in the use and exploitation of the water supplies of Great Britain. It was scarcely to be expected, however, that during the first year of its existence, the Committee would be able to achieve any remarkable results. Its first duty was, naturally, to review the existing conditions and to ascertain the extent to which processes and methods in vogue could be adapted to some uniform and standardized system of procedure. The purpose of the survey, as set out in the Report now issued (London: H.M. Stationery Office. 3*d*. net.), "is to correlate the information at present obtained from all sources, to extend and increase the sources of information, and to make the information readily available for the use of the interests concerned". This has involved exploratory investigations in various directions and the issue of inquiries, which took the form of a detailed questionnaire (reproduced in an appendix to the Report) to which replies have been received from about 3,000 bodies and persons. The replies show that there is a good deal of information available, but that it is varied in type and date, is insufficient and lacks co-ordination and distribution—an endorsement of the conclusions arrived at by the British Association Committee in its report to the Leicester meeting, 1933.

THE present Committee has, accordingly, directed its attention to the means by which an improved system of gauging and recording could be attained. At the same time, it has been conscious of the desirability on economical grounds of adopting as gauging stations a number of structures not originally designed for the purpose, and of obtaining measurements from weirs of a type perhaps not best suited to the end in view. It is of opinion, as advocated in NATURE (Nov. 5, 1932; and again, Aug. 4, 1934), when the matter was first under public consideration, that the Catchment Boards of England and Wales, established under the Land Drainage Act, 1930, are the appropriate bodies to instal gauging stations on rivers and to make and record the measurements of the flow of the rivers which they control. The co-operation of the Catchment Boards has therefore been sought with results which are described as encouraging, and, as there is a large area in England and Wales not yet under the jurisdiction of any catchment board, the Committee has concentrated attention for the time being on areas for which Catchment Boards have been appointed. As regards underground water, the aid of the Geological Survey has been enlisted with the approval of the Committee of the Privy Council for Scientific and Industrial Research. In estimating the value of the existing gauging stations for measuring overground water, an examination has been made of three selected rivers—the Nene, the Thames and the Clyde—and a section of the Report deals with each of them in detail. After setting out its proposals for the publication of data, the Committee concludes the Report with an expression of satisfaction at what it has been able to accomplish in the first year of its existence.

### Britain's Largest Hydro-Electric Development

AN aggregate of 102,000 kilowatt of plant is installed in five power stations in Kirkcudbrightshire and Wigtownshire in the south-west of Scotland. When the Water-Power Sources Committee presented its report in 1924, this portion of Scotland was defined as a place where there were possibilities of water-power development, but it was not surveyed as no commercial outlet for the power could then be visualized. The formation of the Grid, by providing the necessary power outlet, showed how a commercial application was possible, and the present hydro-electric scheme was developed as an important factor in the Central Scotland Grid scheme. In the *Electrical Times* for June 25 there is a detailed account of this scheme, called the Galloway Water Power Scheme, which generates the greatest amount of hydro-electric power of any station in Great Britain. In any power scheme the peak units are by far the most expensive. With steam generation, for example, a large amount of plant capacity has to be provided to cover the period of maximum demand. Daily peaks also occurring at regular intervals are expensive owing to the stand-by coal required. In these circumstances, we can see that hydro-electric plant, which can pick up and drop load at very short notice either in normal operation or in emergency, is a very valuable asset. The Galloway undertaking is unique amongst power stations, as it was planned and carried out as a peak load station instead of supplying the usual basic load. It has already proved valuable

during the sharp rise and fall of the Glasgow industrial load at the midday dinner hour and other similar occasions. It is satisfactory to learn that after the results of the first twelve months' operation of the first half of the scheme, which includes the two power stations of Tongland and Glenlee, having plant aggregating 57,000 kilowatt, the financial future of the undertaking seems assured.

### "Concerning Human Progress"

DR. H. S. HARRISON was characteristically stimulating in his presidential address to the Royal Anthropological Institute on June 30, when he spoke "Concerning Human Progress". Unquestionably his choice of a topic was apt to the needs of contemporary thought, which may well look to the anthropologist for guidance on such questions as the direction and mechanism of human development. Dr. Harrison's conclusions, however, gave his hearers little cause for complacency. He showed no little courage in electing neither to attempt a strict definition of progress, nor to lay down canons of discrimination between upward and downward, in the direction of change. In the event, however, when once he had pointed out that the idea of progress is a modern growth, which did not affect human development until the latter part of the nineteenth century, this deliberate omission enabled him, speaking more especially as a technologist, to demonstrate the essential opportunism of cultural development in the past, which has moved continually forward, backward and sideways, without knowledge of what the direction might be, and not infrequently has led to a dead end. Social progress, he went on to point out, has had no better guidance; but as codes of conduct and actual behaviour are the objective revelations of the mind of man, individually or collectively, and both the material and immaterial products of the human mind have trespassed far beyond the biological necessities, the question arises whether the mind of man has been moulded in response. Dr. Harrison, quite rightly, stressed the apparent paradox that, so far as the evidence goes, there is little, if any, difference to be discerned in physical character and brain power between the earliest example of *Homo sapiens* and the man of to-day. If we look for the directional factor which might have brought about a change in the heart and mind of man, of those forces which have been put forward as active in organic evolution, use-inheritance alone appears to fulfil the requirement, but is ruled out of court, owing to its general repudiation by the biologist. Hence, Dr. Harrison concluded on a note of pessimism, "the mind of man . . . has little sense of direction, and if it may be said to have an ultimate aim, that aim is too obscure for formulation."

### The Osborne Reynolds Ridge

THE recent letters in NATURE from Prof. W. Schmidt and Prof. H. Stansfield, describing their observations of a capillary wave on the surface of water, are a reminder that important published observations may be forgotten for many years. Prof. Stansfield now finds that this phenomenon was described by Osborne Reynolds in 1881. Reynolds produced the wave by dropping oil on water, and also observed it in the open air, perhaps when he was fishing, as he says it looks like a line of gut floating on a river, where the water eddies up to the surface in deep pools. About forty years later, there was fresh activity in the study of moving films. In September, 1921, the late Mr. E. Edser quoted Reynolds's paper at a meeting of the Faraday Society, and described experiments showing that the moving film of oil sets in motion a thin layer of water beneath it. Five years before, in Toronto, Prof. J. Satterly had noticed a 'ripple' which moves up a glass tube in advance of the liquid meniscus, when the tube is being filled from below; this and other effects similar to the Reynolds ridge were under investigation there. Five years later, Burdon of Adelaide published a photograph of oil spreading on the surface of water, clearly showing the Reynolds ridge in advance of the visible oil film; and in the same year, 1926, Edser included this photograph and a discussion of the ridge in Appendix IV of his "General Physics for Students". When the rising generation of physicists see the Reynolds ridge, they should recognize it at once as an old friend.

### Syria and Crete: Further Discoveries

SIR LEONARD WOOLLEY'S further report on his excavations in Syria is a striking justification of the prescience which sought in the area at the mouth of the Orontes evidence for the early relation of the civilizations of Crete and western Asia. The evidence which has been brought to light since the dispatch of his first report (see NATURE of June 13, p. 979) carries the story of the Ægean connexions of Syria from c. 900 B.C., the point at which the settlement at Tell Sheikh Yusuf begins, back to the Middle Minoan age of Crete, somewhere between 1700 and 1580 B.C. At Tell Atchana, a mound near the bank of the Orontes, half-way across the Amk plain in the rear of the Amanus mountains, Sir Leonard reports in *The Times* of June 25, trial excavations in a single trench, which lasted for no more than a fortnight, produced evidence of the existence in the heart of Syria of a city settlement, which was predominantly Cretan in character, and was deserted entirely not later than the twelfth century B.C. At an earlier stage of its history this city had been ravaged by fire and sword, as was shown by the evidence of the large buildings, of which the fire-scarred remains were uncovered. Here the floors were littered with fragments of pottery, among which Syrian wares were mingled with sherds showing characteristic Minoan *motifs*, as well as with specimens of the art of, at present, unknown provenance previously reported. The evidence indicates that the destruction of the building took place before the Late Minoan age began. The find of a Minoan bronze sword is balanced by a Mesopotamian bronze axe and chisels and cylinder seals. The link between Crete and the site on the Amk plain has yet to be demonstrated; but a clue is afforded by the ridge-

top acropolis site at the head of the delta, where surface finds on one hand match the pottery of various periods at Tell Sheikh Yusuf, and on the other include fragments of Mycenæan and Cypriote bronze age wares corresponding with the later levels of Tell Atchana.

### Recent Acquisitions at the Natural History Museum

MRS. CONSTANCE THORBURN has presented to the Department of Zoology of the Museum seventeen water-colour drawings of British mammals executed by her husband the late Archibald Thorburn. Purchases for the Department include a collection of small mammals, mostly rodents, including some rare and little-known species from the Cameroons; and a small collection of European birds obtained on their northward migration in April and May by Mr. C. G. Bird, at Rio d'Oro, on the north-east coast of Africa. Dr. C. T. Trechmann has generously presented to the Department of Geology a large and valuable collection (including more than 200 type and figured specimens) of Mollusca collected by him from the West Indies. The Mineral Department has received as a gift from Mr. Arthur Earland sea-bottom deposits collected from the Weddell Sea in the Antarctic by the "Discovery" expedition, together with the crystals of gypsum, calcium oxalate, and the new mineral earlandite which had been picked by him from the samples collected. Among the purchases is a series of minerals from Brazil, including a beautiful, table-cut, strongly dichroic aquamarine, spodumene of three kinds and quartz in many different forms and habits. A series of well-shaped crystals of lapis-lazuli and three iridescent limonites from Queensland also have been bought.

### Mathematics in Bombay

A VERY interesting experiment in the teaching of mathematics is being carried out in the University of Bombay. Prof. John Maclean, of Wilson College, has had the commendable courage to break away from the beaten track of academic mathematics by devising a special course for his students, dealing mainly with the uses of elementary mathematical methods in the description of quantitative phenomena. The course forms the subject matter of a recent book by Prof. Maclean entitled "Descriptive Mathematics", which was noticed in NATURE of March 7, p. 382. In the Bombay Intermediate Arts and Science examination in March, alternative papers were set; one being of the traditional academic type, whilst the other, entitled "Statistics and Nomograms", was designed to test the efficacy of the new course. Out of a total of 1,400 students, about twenty took this paper. Its questions cover a wide field, and range from Newton's interpolation formula, probability and frequency distributions to transcendental equations and the construction of various types of nomograms. It will be interesting to study the results of this experiment for, judged by the examination paper in conjunction with Prof. Maclean's book, the new course is certainly designed not only to stimulate interest, but also to render a rigorous presentation of the basic ideas in mathematics much more vivid and powerful than that provided by the stereotyped courses.

### Scientific Research in Australia

THE ninth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia (Canberra: Government Printer, 1936. 4s. 8d.), covers the year ended June 30, 1935, and gives brief accounts of the work of the various divisions in which the work is organised. Weed problems are receiving a considerable share of attention, particularly on the entomological side, through the introduction and distribution of insects which attack the plants in other countries. Investigations are being initiated into contagious bovine mastitis, a serious disease prevalent in dairy herds throughout the world, and an attempt is being made to establish at a dairy farm near Melbourne a normal herd free from the disease. The rabbit pest and the testing of seeds continue to receive attention, and in addition to its investigations on weed pests, the Division of Economic Entomology has been investigating means of preventing the attack of sheep by blowflies. The Division of Animal Health has discovered new and more effective methods of administering anthelmintics for the control of internal parasites of sheep, while the Division of Animal Nutrition has studied the 'coast disease' of sheep, drought feeding and the processes of wool growth. Soil problems, timber preservation and seasoning, the preservation and transport of fruit and chilled beef have been investigated by other Divisions. Even the brief accounts of these investigations contained in the present report indicate that the work of the Council is making noteworthy contributions to the welfare of the basic industries and occupations of Australia.

### Geological Survey of Australia

WHEN the Commonwealth of Australia was established, the administration of mining affairs, including geological work, was left with the six independent States. The consequence is that Australia is to-day the only dominion without a national geological survey, a situation which is viewed with grave dissatisfaction by its scientific workers. Every effort hitherto made to remedy the position has failed owing to official opposition from some, but not all, of the State Departments of Mines. A conference between Commonwealth and State officers, held in Melbourne last month, was but little more successful than any of its predecessors. Political, rather than scientific, considerations appear to dominate the issue, and this further failure to agree upon the establishment of a national body, either by the Commonwealth alone or by the States acting jointly, is greatly to be regretted.

### Economic Products of the British Empire

VOL. 34, No. 1 of the *Bulletin of the Imperial Institute* has been published by the Institute itself, but the general format remains practically unaltered. This number contains an important report by the

Imperial Institute Advisory Committee on Hides and Skins on a series of hides prepared experimentally in Southern Rhodesia with the view of improving the material turned out by the natives. It is shown that a simple method of drying the hides which was recommended by the Committee gives excellent results, as it did in the case of earlier experiments in East Africa, and is a great improvement over the ordinary native methods of sun-drying. An article by Mr. M. H. French, of the Tanganyika Veterinary Service, records the work which has been done in that Territory to improve the quality of the clarified butter (ghee) produced there. This product, although little known in Great Britain, is of great importance in tropical regions, since when properly prepared and stored it will keep almost indefinitely under conditions in which ordinary butter turns rancid in a few days. An article by Dr. E. O. Teale, mineral adviser to the Government of Tanganyika Territory, describes recent developments in gold mining in this country. Another article gives a brief outline of the mineral resources of Johore, one of the little-known Unfederated States of Malaya. Alluvial tin ore is being mined in three different areas. In another area iron ore is being mined, and unworked deposits are known to occur in three further regions. Gold and china clay are being produced in small amounts, wolfram has been found in one locality, and prospecting for coal is being carried on in two places.

### National Bureau of Standards

A REPRINT from the annual report of the U.S. Secretary of Commerce, 1935, describes briefly the more important of the developments of the Bureau of Standards during the last twelve months. Scientific workers and engineers are making increasing use of its facilities. The testing of supplies and materials has increased by 15 per cent over the previous year. This is partly due to the building activities of various Government agencies. Having received an exceptionally pure sample of the metal gallium, its freezing point was determined and found to be $29 \cdot 780° \pm 0 \cdot 005°$ C. The melting point of this element is so low that the crystals melt to a liquid on a hot summer day. An investigation has been completed on the efficiency of a large number of rust-preventing materials with particular reference to their use in preventing corrosion in aviation engines during storage. Certain types of materials have been found to be extremely effective for this purpose and for use as general rust preventatives. Laboratory tests of numerous types of oil filters show that some of these devices are most efficient in removing impurities formed in the oil during service. Two formulæ were developed for ink powders which make a writing ink superior to the present federal specification. Work has shown that the superior properties of the English clays are apparently due to the presence in them of certain natural fluxes which are not found in American clays. These fluxes have been identified and studies are now being made of American clays modified by the addition of fluxes. A code for the safety glass used in automobiles has been formulated. It was developed by the co-operation of manufacturers and users of glass and motor-cars. It specifies tests for wire glass, heat-treated glass and laminated glass which ensure satisfactory safety glass.

### Scientific Horticulture

THE fourth year-book of the Horticultural Education Association ("Scientific Horticulture", from the Editor, Mr. R. T. Pearl, South Eastern Agric. Coll., Wye, Kent, 3*s*. 6*d*. net) presents many helpful contributions. Several papers describe the special considerations of gardening in various parts of England, or discuss the horticultural needs of a particular industry, such as cider-making; and the number of articles which achieve the difficult blend of science with practice shows a gratifying increase over previous year-books. There are also articles which summarize the findings of research stations. Dr. W. F. Bewley writes on "Twenty-one years' Glasshouse Research at Cheshunt", whilst Mr. R. B. Dawson portrays the origin and work of the Board of Greenkeeping Research. Prof. R. J. D. Graham has collected the results of the late Laurence Baxter Stewart on vegetative propagation, and his tables, showing the times and seasons when difficult cuttings may be rooted, will be of very real value to gardeners. Plant pathology has two papers: "The *Phytophthora* Disease of Strawberry" by Mrs. N. L. Alcock and Mr. D. V. Howells, and "The Virus Diseases of Glasshouse and Garden Plants" by Dr. K. M. Smith. Very useful reviews of the present position of research into vernalisation and into photoperiod are given by Dr. O. N. Purvis and Prof. F. G. Gregory respectively. Messrs. W. J. C. Lawrence and J. Newell describe "Seedling Growth in Partially Sterilised Soil", and Drs. Kidd and West issue a warning about the gas storage of apples. They show that the harmful concentration of carbon dioxide in the atmosphere of the store varies with temperature and also with the oxygen content. The president of the Association, Mr. H. L. Jones, chose the subject "Horticultural Education in North Wales" as the title of his address. The contributions are rarely reports of new work, but serve, in an admirable manner, to make available the more abstruse, and often isolated, findings of research in pure science.

### *Sands, Clays and Minerals*

THE April number (Vol. 11, No. 4) of *Sands, Clays and Minerals*, published by Mr. A. L. Curtis, Westmoor Laboratory, Chatteris, once again, brings home to readers the fundamental purpose of this magazine. The editorial reiterates that at any rate a partial solution to the problem of unemployment lies in opening up the vast unexploited mineral resources of the British Empire. Numerous industries depend on minerals as raw materials, and increased production leads to increased activity in these industries, with a corresponding fall in unemployment. Certain minerals now being obtained from foreign sources might be produced wholly or in part within the British Empire. Obstacles to optimum development of such resources are not irremovable, though at the present time they

loom large. Possibly if the responsibility for economic development were taken from bureaucratic bodies and sharply dissociated from political circles, a more rapid advance could be achieved. It is the practical men, technologists and experts who are best equipped to regulate development of mineral wealth now lying dormant within the boundaries of the Empire. Indirectly such men are already furthering this object, both in an advisory capacity and by their contributions to magazines such as this. Several articles follow in illustration of the importance of mineral wealth. Mr. W. G. Boden writes of Canadian radium, showing how important it has become in the fight against cancer. Mr. L. Sanderson describes the rare metal niobium found in association with columbite and which is destined to play an important part in steel stabilisation and welded construction for service in the embrittling zone of temperatures. In addition there are descriptions of the mineral wealth of East Africa, Southern Rhodesia and the Gold Coast. Publicity of this character obviously furthers the case for utilization of British resources to meet British demands.

### Distribution of Insecticide by Shot-Gun

IN a report from Science Service (Washington, D.C.) dated April 25 a patent is announced, and briefly described, embodying the application of insecticides by means of shells discharged from a kind of gun. The idea is an American invention, which claims that shot-gun shells can be loaded with compressed wads of insecticide instead of lead shot. When such a shell is fired, the force of the explosion ejects a wad like a bullet, and when it has travelled a certain distance, it breaks down into a cloud of ultra-fine dust. The distance at which the dissolution of the wad will occur depends upon its make-up—its compactness and moisture content. This distance, it is claimed, can be calculated so that the dust cloud can be discharged on a desired tree or crop. The advantages of the method, as claimed by the inventor, are safety of the operator from the effects of a toxic dust; elimination of cumbersome and explosive spray or dusting equipment; practically no labour; and effective distribution of an insecticide in otherwise inaccessible places.

### Biochemical Research at the Franklin Institute

WE have received the third volume (1934–35) of "Reports of the Biochemical Research Foundation of the Franklin Institute". In a foreword, the director, Dr. Ellice McDonald, points out that this issue marks the withdrawal of the Cancer Research Laboratories of the Graduate School of Medicine from the University of Pennsylvania and their inception as the Biochemical Research Foundation of the Franklin Institute. The ostensible reason for this withdrawal is the refusal of the University to allow patenting of medical or biochemical discoveries for the continued furtherance of research activities, though not for personal profit. The Institute has decided that the past research done on the cancer problem should be made an avenue of approach to the more general area of other diseases. The objects of the new Foundation are the study of the processes of disease from a chemical point of view, the study of new organic chemical compounds for their therapeutic value and the study of longevity and the diseases of age, with the hope of prolonging the span of life. The present volume contains reprints of some thirty papers published by the staff of the Institute and the Cancer Research Laboratories and their colleagues, dealing in general with various aspects of both normal and abnormal tissue metabolism.

### Business Mental Activity and Management

MR. W. R. DUNLOP, of 57 Gordon Square, London, W.C.1, who for a number of years has been interested in the study of business mental activity from the point of view of management and administration, and with particular reference to the logic and probability of decisions, desires to get into touch with a logician with a taste for probability arguments and a psychologist interested in the underlying psychological factors. It is desired, if possible, to arrange a private meeting for joint discussion at which an experienced business manager with introspective ability would also be present. The object would be to get a combined opinion on Mr. Dunlop's method and to make proposals for further studies and investigation. Mr. Dunlop would be greatly obliged if any reader would assist him in getting into touch with specialists willing and competent to collaborate in the direction indicated.

### Thomas Gray Memorial Trust

THE Royal Society of Arts, through the Thomas Gray Memorial Trust, the objects of which are "the advancement of the Science of Navigation and the Scientific and Educational interests of the British Mercantile Marine", is offering the following prizes for competition in 1936: a prize of £100 to any person who may bring to their notice an invention, publication, diagram, etc., which is considered to be an advancement in the science or practice of navigation, proposed or invented by himself in the period January 1, 1931–December 31, 1936; a prize of £100 for an essay on the following subject: "What are your views as to the effectiveness or otherwise of Part II. of the Merchant Shipping (Safety and Load Line Conventions) Act, 1932, with special reference to vessels engaged in the carriage of oil and timber cargoes, and with particular regard to actual sea experience ?" Further information can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2.

### International Association for Quaternary Studies

THE Association internationale pour l'Étude du Quaternaire européen, which met last at Leningrad in 1932, will hold its third session at Vienna on September 1–5. Prof. A. Penck is honorary president, Prof. G. Götzinger is president and Dr. O. Ampferer is president of the Organizing Committee. On this occasion, however, in accordance with a resolution passed at Leningrad, the scope of the Congress is to be the Quaternary in general and not the Quaternary of Europe only. Communications have already been

promised on questions previously arranged for discussion in relation to the Quaternary of Austria and the Alpine glaciations covering stratigraphy, chronology, morphology, climate, prehistory and speleology. MM. Menghin, Kyrle, Beninger and Liebus will devote attention to the palæolithic period. Arrangements have been made for two excursions while the Congress is in session. Of these, one will visit the loess regions of the Danube Valley (Gottweig, Krems) and the other those in the neighbourhood of Vienna (Laaerbeg). At the close there will be a one-day excursion to the Drachenhöhle of Mixnits, while on September 7–8 an excursion will visit the loess of Weinviertel. Finally, a long excursion has been arranged for September 9–25, to visit the Austrian Alps and adjacent terrain. An illustrated guide-book is in course of preparation. Membership is a condition of attendance at the Congress, the annual subscription being 10 schillings (Austrian) or two dollars. In addition to the privilege of attendance at the Congress, members receive copies of reports which cover the progress of quaternary studies from 1908 until 1935. There are at present 180 members of the Congress drawn from twenty-five nations. Communications relating to the Congress or to membership should be addressed to Drs. Götzinger and Ampferer, Geologische Bundesanstalt, Rasumofskygasse, Wien III, or to the General Secretary, Herr H. Gams, Botanische Institut, Innsbruck-Hötting.

## Announcements

IT is announced that the Right Hon. Viscount Hailsham, the Lord Chancellor, has accepted the chairmanship of the British Empire Cancer Campaign.

AT the meeting of the Paris Academy of Sciences on May 25, Paul Portier was elected a member of the Section of Medicine and Surgery, in succession to the late Charles Richet.

DR. H. J. PLENDERLEITH, of the British Museum Research Laboratory, has been appointed professor of chemistry at the Royal Academy in succession to Dr. A. P. Laurie, whose term of office has expired. The professor of chemistry gives six lectures at the Royal Academy, in October and November. They are primarily intended for the Royal Academy students, but are open free to students of other art schools and Royal Academy exhibitors of the year who may wish to attend.

THE Council of the Royal Meteorological Society has awarded the Howard Prize for 1936 to Cadet John Burton Davies, of H.M.S. *Worcester*. The subject of the competition was an essay on "The Causes of Fog over the Open Sea and in Coastal Waters".

WE much regret that the name of Prof. A. C. Seward, who is retiring from the chair of botany in the University of Cambridge which he has held since 1906, was inadvertently omitted from the list in NATURE of June 27, p. 1063, of those on whom the honour of knighthood has been conferred.

ON the occasion of the Congress of Psychiatry held at Rome on April 3, a bust of the neurologist and psychologist, Prof. Sancte de Santis, was unveiled by Prof. Ponzo.

DR. MARSHALL C. BALFOUR, representative in Greece of the International Health Board of the Rockefeller Foundation, has been awarded the silver medal for distinguished services by the Greek Academy of Sciences, Arts and Letters in recognition of his researches on malaria control in the Peloponnese and Macedonia.

THE eleventh International Congress of Psychology will be held at Madrid on September 6–12 under the patronage of the Spanish Republic and the presidency of Prof. E. Mira of Barcelona. The official languages will be Spanish, English, French, German and Italian. Further information can be obtained from the general secretary, Dr. José German, Instituto Nacional de Psicotecnica, Alberto Aguilera 25, Madrid.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in anatomy in the University of Birmingham—The Secretary (July 7).

A scientific officer (physics or engineering) in a Government establishment in the south of England —The Secretary, Royal Engineer Board, Regent's Park Barracks, Albany Street, London, N.W.1 (July 7).

A technical assistant (male) in the Air Defence Experimental Establishment, Biggin Hill, Kent—The Superintendent (July 7).

A lecturer in production engineering in the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (July 9).

An assistant lecturer in civil engineering in the City and Guilds College, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7—The Secretary (July 10).

Chemists (male) at the War Department Chemist, Woolwich Arsenal—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (July 10).

A lecturer in mechanical engineering in the Heanor Mining and Technical School—The Director of Education, County Education Office, St. Mary's Gate, Derby (July 11).

Two assistants (Grade I), one assistant (Grade II) and two junior assistants in the Directorate of Explosives Research; and an assistant (Grade II) in the Directorate of Metallurgical Research in the Research Department, Royal Arsenal, Woolwich—The Chief Superintendent (July 11).

A lecturer in mathematics in the University of Aberdeen—The Secretary (July 17).

A lecturer in physiology in the University of Birmingham—The Secretary (July 17).

A demonstrator in human physiology in the University of Manchester—The Registrar (July 18).

A professor of social anthropology in the University of Oxford—The Registrar.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 39.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Correlation between Scattering and Recoil in the Compton Effect

As is well known, the experiments of Bothe and Geiger[1] and of Compton and Simon[2] on the correlation between scattering of individual X-ray quanta and electron recoil gave results in complete agreement with the theoretical explanation of the Compton effect, based on the conservation of energy and momentum in each scattering process. The entirely negative results of the recent attempt by Shankland[3] to find such a correlation in the scattering of $\gamma$-rays from radium was therefore most unexpected, and it seems desirable to repeat the experiments under conditions as well defined as possible and especially using the much more homogeneous $\gamma$-rays from thorium[4].

For this purpose, experiments have been carried out, using a source of 10 mgm. of RaTh filtered by 0·5 cm. lead. The $\gamma$-rays next passed through a hole of cross-section 1 — × 1·5 cm. in a lead block 30 cm. thick. The scattering angle was 30° both for the electrons and the quanta, the scatterer was a sheet of paraffin wax of 0·05 cm. thickness. A single counter was used for the detection of the scattered quanta and one for the electrons; the two counters were identical except that the electron counter had an aluminium window with thickness 0·04 mm. and diameter 2 cm. The distance from the counter to the scatterer was about 8 cm.

In a single experiment the coincidences were counted together with the kicks in each of the counters. To determine the number of chance coincidences a lead sheet of thickness 2 mm. was placed in front of the $\beta$-counter; the reduction in the number of single kicks caused by the presence of the lead plate was counterbalanced by placing a weak source of RaD close to the electron counter. The number of kicks in the $\gamma$-counter was not changed by this procedure. The coincidences found with the lead plate in position give the number of chance coincidences in the first experiment. The following results were obtained in two different series of experiments:

| | Kicks per minute | | | | Coincidences per hour | | |
|---|---|---|---|---|---|---|---|
| | Without scatterer $\beta$ | Without scatterer $\gamma$ | With scatterer $\beta$ | With scatterer $\gamma$ | Total (without lead plate) | Chance (with lead plate) | Difference |
| I | 120 | 28 | 195 | 29 | 6·5 ± 0·6 | 2·3 ± 0·3 | 4·2 |
| II | 120 | 120 | 195 | 121 | 11·7 ± 0·9 | 8·6 ± 0·7 | 3·1 |

In the second experiment the number of chance coincidences was increased by exposing the $\gamma$-counter to a weak source of RaD. The experiments show that coincidences exist between the $\beta$- and the $\gamma$-counter in a number which is well beyond the experimental error.

The number of kicks in the $\gamma$-counter due to the presence of the scatterer was 1·0 per minute. This was found by replacing the scatterer by a block of paraffin wax of known weight, the proportionality between the weight of the scatterer and the number of kicks being tested by separate measurements. If for each scattered quantum recorded by the $\gamma$-counter the corresponding electron was recorded by the $\beta$-counter, the number of coincidences would thus be 1·0 per minute. This is, however, reduced considerably by a number of circumstances, such as lack of homogeneity of the primary radiation, scattering within the scatterer, etc., which are difficult to take into account accurately. A rough estimate gives for the expected number of coincidences about 8 per hour, in substantial agreement with the value actually found.

These experiments would, therefore, seem to confirm the usual theory of the Compton effect in every respect.

J. C. JACOBSEN.

Institute of Theoretical Physics,
Copenhagen.

[1] *Z. Phys.*, **32**, 639 (1925).
[2] *Phys. Rev.*, **26**, 289 (1925).
[3] *Phys. Rev.*, **49**, 8 (1936).
[4] Since the experiments recorded above were finished, an account of similar experiments leading to the same results has been published by Bothe and Maier-Leibnitz (*Göttingen Nachr.*, **10**, 127; 1936).

## Conservation Laws in Quantum Theory

IN connexion with the new experiments on the correlation between scattering and recoil in the Compton effect by Bothe and Maier-Leibnitz, as well as those by Dr. Jacobsen recorded above, both contradicting the conclusions regarding the absence of such a correlation arrived at by Shankland, I should like to make the following brief comments upon the renewed discussion[1] on a possible failure of the laws of conservation of energy and momentum in atomic phenomena, to which Shankland's experiments have given rise.

When in an early attempt[2] at a generalisation of the classical radiation theory suited to meet the puzzling dilemma of the wave and corpuscular character of radiation, doubts were expressed regarding the validity of the conservation laws for individual quantum processes, the situation was quite different from what it is to-day. Not only have subsequent experimental discoveries made us familiar with similar paradoxes regarding the behaviour of electrons and other material particles, but above all has the establishment of rational methods of quantum mechanics and electrodynamics proved the compatibility of the existence of the quantum of action with the strict validity of the conservation laws in all such phenomena as electron diffraction and Compton effect. Moreover, the examination, initiated by Heisenberg, of the complementary limitations in quantum theory of measurements of mechanical quantities as well as of electromagnetic field components[3] has completely removed every paradox in

this respect. The essence of the argument may be said to be that any attempt at an unambiguous space-time co-ordination in quantum phenomena implies a renunciation of the strict application of the conservation laws, due to the essentially uncontrollable exchange of energy and momentum between the object under investigation and the rigid bodies and clocks which define the space-time frame; conversely, any well-defined application of the conservation laws in quantum phenomena implies an essential renunciation as regards space-time co-ordination[4].

As the fundamental relations between the wave and particle aspects of light and matter can be expressed in full conformity with the relativity principle, the still unsolved difficulties of quantum electrodynamics, emphasised by Dirac in connexion with this discussion, can scarcely be attributed to any incompatibility between the foundations of quantum theory and relativity theory. The root of these difficulties may rather be looked for in the atomistic nature of electricity, which is as foreign to classical physical theories as the quantum of action itself. The rational incorporation of these different aspects of atomic problems in a comprehensive theory will probably claim entirely new points of view, taking the essentially atomistic structure of all measuring agencies into consideration; but at the moment there would seem to be no reason to expect that this would involve any real departure from the conservation laws of energy and momentum.

Finally, it may be remarked that the grounds for serious doubts[5] as regards the strict validity of the conservation laws in the problem of the emission of β-rays from atomic nuclei are now largely removed by the suggestive agreement between the rapidly increasing experimental evidence regarding β-ray phenomena and the consequences of the neutrino hypothesis of Pauli so remarkably developed in Fermi's theory.

N. BOHR.

Institute of Theoretical Physics,
Copenhagen.
June 6.

[1] P. Dirac, NATURE, 137, 298 (1936). E. J. Williams, NATURE, 137, 614 (1936). R. Peierls, NATURE, 137, 904 (1936).
[2] N. Bohr, H. A. Kramers and J. C. Slater, *Phil. Mag.*, 47, 785 (1924).
[3] N. Bohr and L. Rosenfeld, *Kgl. Danske Vidensk. Selsk. math.-fys. Medd.*, 12, 8.
[4] N. Bohr, *Phys. Rev.*, 48, 696 (1935).
[5] N. Bohr, Faraday Lecture, *J. Chem. Soc.*, 349 (1932).

## $[SO_3]_x$

MESSRS. Gerding, Nijveld and Muller[1] infer from the Raman spectrum of sulphur trioxide that it is a mixture of polymorphs. It is interesting to have such information, but to chemists who have known the compound this has always been a necessary assumption.

I remember Frankland introducing me to sulphuric anhydride early in 1867, at the Royal Institution, where we were doing gas analysis with the Frankland and Ward apparatus. He distilled it out of Nordhausen acid, using a bulb blown on the spot from an odd bit of tube, heating the small still on a warm tile of a Hofmann combustion furnace. To-day I can see him doing this: it was the way he had of showing one how to use one's fingers. Somehow I fell in love with the silken beauty of the oxide. As a German student, it was my first research *Schatz*: I cultivated its more acquaintance by the kilo, to the surprise of my fellow students and even of Kolbe.

I am carried back to 1868, when I tested its action on a large number of chlorides. Typical is the effect it has on carbon tetrachloride, forming carbonyl chloride and pyrosulphuryl chloride, $S_2O_5Cl_2$, it would seem directly, as $SO_2Cl_2$ and $SO_3$ do not combine. On the other hand, the anhydride combines readily with HCl and EtCl forming simple chlorides—compounds which behave, however, as though they were the trioxide: they are not active apparently through their chlorine, as indeed is the case with acid chlorides generally. Pyrosulphonyl chloride is both a sulphonating and a chlorinating agent; sulphonyl chloride chlorinates.

The peculiarities of the 'trioxide' are not sufficiently recognized. It has high residual affinity. It is the perfect sulphonating agent, used alone but preferably diluted with sand. $SO_3HCl$ is a convenient form in which to administer it—not nearly so powerful; the anhydride may even be used in solution in $SO_3HCl$ with effect. I always feel proud of having introduced this chloride into use; it has played a big part in the manufacture of saccharin.

No text-book does justice to the protean character of the sulphuric acids: their properties have been Ostwaldized into oblivion. $\frac{1}{2}H_2SO_4$ is not the equivalent of the acid: it is 90 per cent a monosulphonic acid—the lactic acid of the sulphur series—not dihydric sulphate. The well-defined stable acid of the series is anhydrosulphuric acid—*oxodisulphonic acid*. The first product of the interaction of vitrolic acid and, say, salt or sodium nitrate is not the acid sulphate of the text-books but $H_3Na(SO_4)_2$—a fact which makes the use of nitre in nitrations uneconomic. When chemists some day recover the full use of symbols and pay attention to facts, these and not a few other matters will receive the attention too long denied to them. Sulphonation is the most important of all the processes in the dyestuff industry—and we owe it to Faraday.

HENRY E. ARMSTRONG.

55 Granville Park,
Lewisham, S.E.13.

[1] NATURE, 137, 1033 (June 20, 1936).

## Kinetics of Gas Reactions: an Attempt to Connect Thermal Decomposition and Oxidation Processes

THE thermal decomposition of formaldehyde[1] and of acetaldehyde[2] can be represented by $x-t$ graphs which indicate a period of rapid decomposition, followed by one of slow decomposition. The experimental results of Spence[3] for the rates of oxidation of formaldehyde appear to be represented by similar graphs, indicating a similarity in the processes. Seddon and I have pointed out[4] that, in the case of acetaldehyde, the total rate of thermal decomposition appeared to be independent of all conditions except temperature and initial concentration, the nature of the final products, whether methane and carbon monoxide on one hand, or propylene, carbon dioxide and water on the other, being materially dependent on certain other conditions.

Now in the case of the oxidation of formaldehyde, it appears that the final stage in the process follows two alternative courses, which may be represented by,

$$(CH_2O_2) \begin{array}{l} \nearrow CO_2 + H_2 \\ \quad\;\; \text{or} \\ \searrow CO + H_2O. \end{array}$$

Spence refers to the penultimate stage as involving the formation of "activated formic acid", but it is perhaps wise to avoid the nomenclature of organic chemistry, and speak of a "short-lived intermediate" of composition ($CH_2O_2$).

One may imagine that the system passes through a series of states defined by symbols $X$, $X_1$ . . . $X_x$ . . . $X_{(n-2)}$, $X_{(n-1)}$, $X_n$. To account for the similarity between oxidation and thermal decomposition processes, it seems to be necessary to assume that there is some change which is dominant and common to both, and I suggest that this is to be found in the transition represented by,

$$X_{(n-2)} \rightarrow X_{(n-1)}.$$

This is the change involved in the formation of the short-lived intermediates. The probability of reversal of this process is, as Seddon and I suggest, small, and the energy drop considerable. The energy is utilized in a process represented by,

$$X \rightarrow X_1,$$

that is, in increasing the probability of the formation of new primary centres.

The suggestion is somewhat similar to one of those put forward by Semenoff. Qualitatively, it would involve the initial acceleration of the process, which would afterwards slow down. In a considerable number of processes, involving relatively small energy changes, which have been investigated in this laboratory by means of detailed analyses, the form of the $x-t$ graphs is very similar, showing a very sudden transition from rapid to slow reaction generally at or before 50 per cent change. This seems to happen in the case of the oxidation of formaldehyde and in the thermal decomposition of acetaldehyde.

M. W. TRAVERS.

Chemistry Department,
University, Bristol.

[1] Fletcher, *Proc. Roy. Soc.*, A, **146**, 357.
[2] Travers and others, *Proc. Roy. Soc.*, A, **146**, 250, and in the press.
[3] *J. Chem. Soc.*, 649 (1936).
[4] NATURE, **137**, 906 (1936).

## Vitamin P: Flavonols as Vitamins

VARIOUS chemical and clinical observations have led to the assumption that ascorbic acid is accompanied in the cell by a substance of similar importance and related activity. In absence of both substances, the symptoms of lack of ascorbic acid (scurvy) prevail and conceal symptoms of the deficiency of the second substance. In the lack of suitable experimental animals or conditions, progress was dependent on spontaneous pathological conditions, caused or influenced by this second factor.

In collaboration with L. Armentano and A. Bensáth, we have found that in certain pathological conditions, characterised by an increased permeability or fragility of the capillary wall, ascorbic acid is ineffective, while the condition can readily be cured by the administration of extracts of Hungarian red pepper ('vitapric') or lemon juice. The extracts were effective in cases of decreased resistance of the capillary wall toward whole blood (vascular type of hæmorrhagic purpura) as well as in cases in which the capillary wall showed an increased permeability towards plasma protein only (various septic conditions). The extracts were fractionated. The active substance was found in the end in a fraction consisting of practically pure flavon or flavonol glycoside. 40 mgm. of this fraction given daily intravenously to man restored in a fortnight regularly the normal capillary resistance. Spontaneous bleeding ceased, the capillary walls lost their fragility towards pressure differences and no more plasma protein left the vascular system on increased venous pressure.

These results suggest that this great group of vegetable dyes, the flavons or flavonols, also play an important role in animal life, and that the dyes are of vitamin nature. The group is not to be confused with the yellow dye, discovered by one of us and termed 'flaves' (like cytoflave), which dye forms the prosthetic group of Warburg's yellow enzyme and has later been renamed by R. Kuhn 'flavins'. We propose to give the name 'vitamin P' to the substance responsible for the action on vascular permeability.

This research is sponsored by the Josiah Macy Jr. Foundation, New York.

ST. RUSZNYÁK.
A. SZENT-GYÖRGYI.

I. Medical Clinic and
Biochemical Department,
University, Szeged.
May 27.

## Role of Adenylic Acid in Vitamin $B_1$ Deficiency

THE work of Peters[1] and his collaborators has shown that abnormal amounts of lactic and pyruvic acid accumulate in the brain of the polyneuritic pigeon. Further evidence of the Oxford school has demonstrated that the brain tissue of such polyneuritic pigeons exhibits a lowered oxygen consumption in the presence of either pyruvic or lactic acid. The addition of vitamin $B_1$ *in vitro* to such tissue restores the oxygen uptake to a large extent. Other workers[2] have also pointed out the presence of excessive amounts of lactic acid in the tissues of the vitamin $B_1$ deficient animal. This emphasis on the 'lactic acid' theory of the vitamin $B_1$ syndrome led Drury, Harris and Maudsley[3] to suggest that the bradycardia found by them in vitamin $B_1$ deficient rats was due to the excessive accumulation of lactic acid in the heart. No direct evidence was brought forward to support this theory, although the results of Birch and Harris[4] showed that the severity of the bradycardia went parallel with the lactic acid level in the blood.

The attention which has been devoted to this theory has obscured the similarity between the effect of adenine nucleotides on the normal heart and the effect of vitamin $B_1$ deficiency on this organ. In the rat, the bradycardia produced by certain adenine compounds apparently resembles in all respects that produced by avitaminosis $B_1$. For example, with moderate avitaminosis or with small doses of adenylic acid, the heart exhibits a simple slowing. In severe avitaminosis when the heart rate is below 350 beats per minute the auricular wave disappears[3]. This disappearance of the auricular wave also occurs when a large enough dose of adenylic acid is injected.

These facts have led us to study the action of adenine nucleotides on the heart of both the normal and vitamin $B_1$ deficient animal.

It was found possible to increase further the bradycardia already present, due to vitamin $B_1$ deficiency, by the injection of small amounts of adenosine, or either of the adenylic acids from muscle or yeast. Using normal animals, a much smaller effect was

obtained with the same dosage of these substances. The results using muscle adenylic acid are shown in Fig. 1.

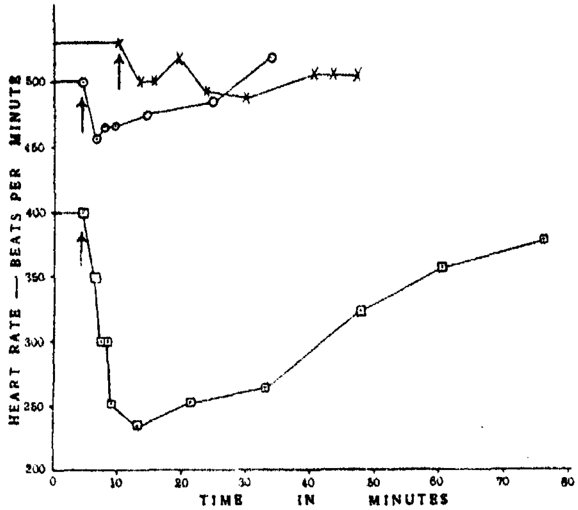



FIG. 1. Effect of muscle adenylic acid on heart rate. 3 mgm. of the acid were injected at points marked by the arrows. ⊡, Vitamin $B_1$ deficient animal; ×, same animal 18 hours after administration of vitamin $B_1$; ⊙, animal on 'stock diet'.

These experiments demonstrate that the vitamin $B_1$ deficient animal is more sensitive to the action of these compounds. This increased sensitivity disappears completely 18 hours after the administration of vitamin $B_1$, the heart rate having by this time returned to its normal value.

These results suggest that the $B_1$ deficient animal is unable to render these compounds innocuous at the same rate as does the normal animal.

The two known mechanisms whereby the adenylic acids are converted into substances having little or no effect on cardiac muscle are (1) deamination to ammonia and inosinic acid; (2) phosphorylation to adenosine di- or tri-phosphate.

We have as yet studied only the first of these mechanisms, and have established the fact that the deaminase activity of vitamin $B_1$ deficient cardiac tissue is on the average more than 20 per cent lower than similar tissues from control animals on a full 'stock diet'. Moreover, tissue obtained from cured animals 18 hours after administration of the vitamin shows a deaminase activity equal to that of normal animals.

Ammonia Produced in 40 minutes per gram of Heart Tissue

| | Normal | $B_1$ deficient |
|---|---|---|
| | 1,010 γ | 778 γ |
| | 998 ,, | 710 ,, |
| | 1,041 ,, | 752 ,, |
| | 987 ,, | 807 ,, |
| | 918 ,, | 955 ,, |
| | 875 ,, | 695 ,, |
| | 995 ,, | 725 ,, |
| | 1,072 ,, | 845 ,, |
| Average | 982 ,, | Average 783 ,, |

We have not yet succeeded in obtaining this restoration of deaminase activity by the direct addition of vitamin $B_1$ to deficient tissue *in vitro*. This fact, as well as the delayed recovery in the heart rate after administration of vitamin $B_1$, may indicate that in the rat the vitamin must first be synthesised into another compound before its biological action is manifest.

It seems possible that this failure of the deaminase mechanism may result in an increased accumulation of adenylic acid in the tissue, which is the cause of the bradycardia. Likewise, many of the effects obtained with vitamin $B_1$ deficient tissues (for example, increased lactic acid and decreased oxygen consumption) may be due to the inhibition by adenylic acid of the oxidative mechanisms which are responsible for the removal of these metabolytes.

T. W. BIRCH.
L. W. MAPSON.
Nutritional and Biochemical Laboratories,
Cambridge.
May 22.

[1] Kinnersley and Peters, *Biochem. J.*, 23, 1126 (1929). Meiklejohn, Passmore and Peters, *Proc. Roy. Soc.*, B, 111, 291 (1932).
[2] Hayasaka, *Tôhoku J. Exp. Med.*, 14, 72, 85, 283, 487 (1930).
[3] Drury, Harris and Maudsley, *J. Biol. Chem.*, 78, 335 (1930).
[4] Birch and Harris, *Biochem. J.*, 28, 602 (1934).

## Equivalent Particle-Observers

MILNE[1] and Page[2] have attempted to build up relativistic theories without employing the concepts of *rigid body* or *absolute clock*. Now we can certainly abandon one of these concepts. The possibility of getting rid of the rigid body (assuming an absolute clock) was pointed out by me some time ago[3], while (assuming rigid bodies) we can avoid the absolute undefined clock by employing a light ray oscillating between mirrors at the end of a rigid rod. But to proceed with *neither* concept, as Milne and Page appear to do, is not possible.

Basic in the theories of Milne and Page is the concept of *equivalent particle-observers*. A *particle-observer* is simply a particle equipped with a clock, not an absolute clock, of course, but just any clock that assigns a monotonically increasing sequence of numbers to the events that occur at the particle. According to Milne (*loc. cit.*, p. 30) two particle-observers are *equivalent* if their clocks can be so regulated that, on exchange of light signals between them, there exist certain relations between times of departure and reception of the signals. Page (*loc. cit.*, p. 256) states that in similar circumstances the *clocks* are equivalent, "or that the two particle-observers are equivalent".

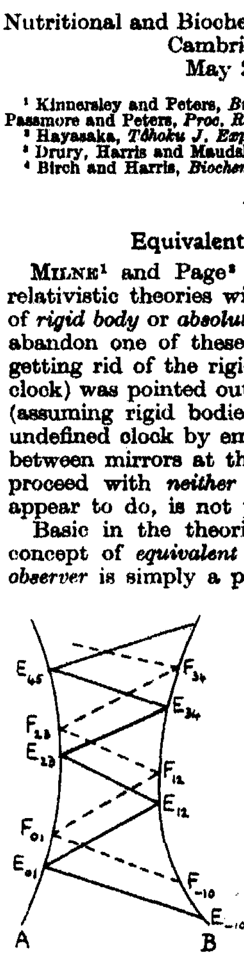



FIG. 1.

This idea of equivalence, at least so far as just two particle-observers are concerned, seems quite a hollow one, because (as will be shown below) *any two particle-observers are equivalent*. Further, the statement that two particles have a *constant relative velocity* is devoid of any absolute physical meaning in terms of the definitions employed (provided that we think only of two particles), because it is always possible by proper choice of 'equivalent' clocks to make this velocity zero.

Consider the world-lines of two particle-observers $A$, $B$ (Fig. 1). Starting with any event $E_{01}$ in the history of $A$, we may construct a 'ladder' by means of a light ray passing to and fro between $A$ and $B$, the 'corners' of the ladder being the events . . . $E_{-10}$,

$E_{01}$, $E_{12}$, $E_{23}$, . . . as shown. Let us choose any positive number $k$ and assign to the events of $A$ between $E_{01}$ and $E_{23}$ a time parameter $t$, arbitrary except for the conditions that it shall increase monotonically from $t=0$ at $E_{01}$ to $t=2k$ at $E_{23}$. Let $F_{01}$ be any event in the interval ($E_{01}$, $E_{23}$) and let its time be $t$. Let us construct the ladder having $F_{01}$ for a corner and let us assign to the events at the corners of this ladder (both on $A$ and on $B$) values of $t$ such that

$$t(F_{n,n+1})=t(F_{n-1,n})+k, \quad (n=\ldots-1,\ 0,\ 1,\ 2,\ldots).$$

Letting $F_{01}$ range over ($E_{01}$, $E_{23}$), we assign by this process a value of $t$ to every event in the histories of both particles, the assignment of $t$ over ($E_{01}$, $E_{23}$) remaining arbitrary except for the terminal values (0, $2k$).

The time-systems assigned as above satisfy the conditions of equivalence of Milne and Page. Thus any two particles are equivalent. Incidentally, on account of the arbitrary choice of $t$ in ($E_{01}$, $E_{23}$) it is obvious that the following statement of Page is not true (*loc. cit.*, p. 257): "The readings of the clocks of $P$ and $P'$ are fixed to within an arbitrary additive constant by the condition that they be equivalent." Furthermore, the 'distance' of Milne and Page between the two particles is constant for equivalent clocks defined as above. Their 'relative velocity' is zero.

It would seem that both Milne and Page have permitted their partially arbitrary clocks to assume an absolute significance. It must be understood, however, that the above remarks apply only to a system of two particles. With more particles the question of equivalence may take on more physical reality.

J. L. SYNGE.

Department of Applied Mathematics,
University of Toronto.
April 23.

[1] E. A. Milne, "Relativity, Gravitation and World-Structure" (Oxford, 1935).
[2] L. Page, *Phys. Rev.*, **49**, 254-268 (1936).
[3] J. L. Synge, NATURE, **108**, 275 (1921).

## Time Effects in Supra-conductors

IN continuation of previous investigations on the magnetic hysteresis phenomena in supraconductors, we have recently reported on experiments concerning the time effect[1]. We observed that after a sudden change of one of the variables of state (magnetic induction or temperature), a final value of the induction in a long supra-conducting cylinder was only attained after a considerable time (up to 20 minutes). The effect was strongest in single crystals and very pure polycrystalline specimens.

As a possible explanation, we tentatively suggested that the redistribution of supraconductive and normal material was perhaps delayed by the slow dying-out of induced currents in the boundary surface between the two states. Such an explanation necessitates, of course, the existence of macroscopic supra-conductive and normal regions in the specimen. It has been recently worked out by R. Peierls[2] and F. London[3] independently (we are much indebted to both authors for giving us an opportunity to acquaint ourselves with the theories before publication, and for the permission to quote their results), that the existence of such macroscopic regions is unlikely in a sphere,

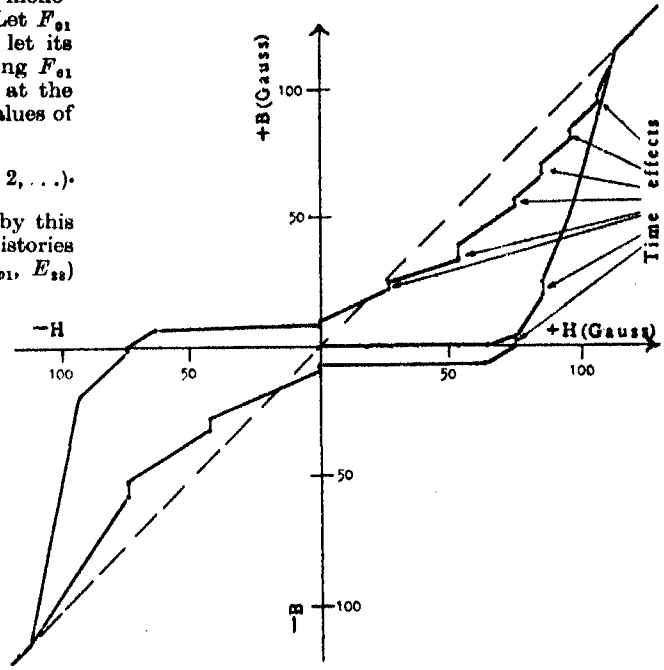



FIG. 1. *B/H* curve of short cylinder of polycrystalline tin, temperature constant, 2·842° K.

whereas the assumption of such a region seems to us necessary in a body of a more complicated form, for example, a short cylinder.

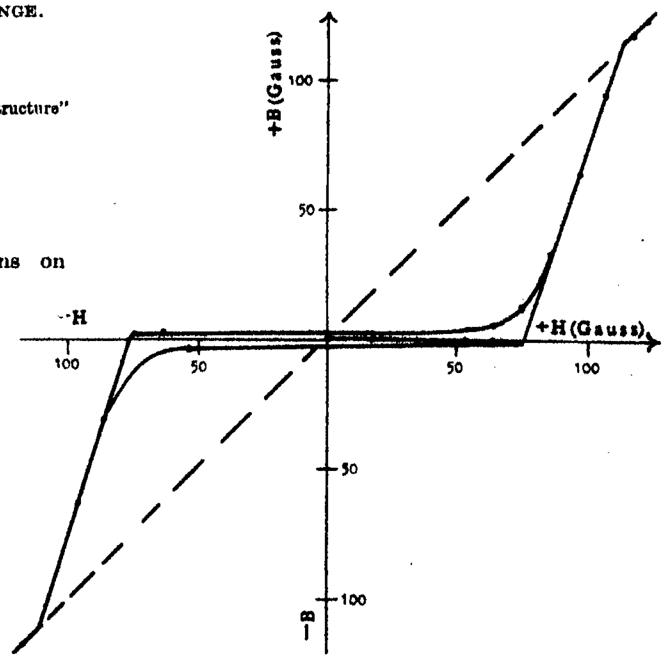



FIG. 2. *B/H* curve of sphere made from cylinder of Fig. 1, temperature constant, 2·85° K.

We have therefore determined the relation of the induction ($B$) to the external field ($H$) in a short cylinder of very pure polycrystalline tin. The result

is given in Fig. 1, and it can be seen that when the external field is altered, it takes in many cases an appreciable time before a final value of the induction is reached.

After this experiment, the cylinder was worked down carefully to the shape of a sphere. The change of induction observed now (Fig. 2) is nearly reversible, and no time effects were observed.

In both experiments, the first determination of the induction was carried out about 10–15 seconds after the field had been changed. In the second experiment, no variation of induction was observed after this time, whereas a variation was observed even after 3–4 minutes in the first case.

The results show clearly that in the same sample time effects may or may not occur, and that their occurrence depends on the geometrical form of the specimen. Considering the facts stated above, the experiments seem to confirm our assumption that the time effects indicate a slow expansion or contraction of macroscopic supra-conductive regions.

K. MENDELSSOHN.
R. B. PONTIUS.
Clarendon Laboratory,
Oxford.
May 16.

[1] K. Mendelssohn and R. B. Pontius, *Physica*, 3, 327 (1936).
[2] R. Peierls, *Proc. Roy. Soc.*, A, in print.
[3] F. London, *Physica*, in print.

## Determination of Physico-Chemical Constants

THE high sensitivity of W. Swietoslawski's ebulliometric test of the purity of liquid substances[1] permits the correlation of data for any physico-chemical property with $\Delta t$, the difference between the boiling point and condensation temperature of the substance under investigation, in order to calculate the constants for the pure substance or azeotropic mixture.

The difference mentioned, $\Delta t$, when measured in an ebulliometer of standardised dimensions, is a criterion of purity of liquid substances, and for a pure substance it equals zero. Having made measurements of $\Delta t$ and of a given constant for a series of preparations of the same compound having different degrees of purity, as for example a few successive fractions of distillate from an efficient column, one may plot $\Delta t$, the difference between the boiling point and temperature of condensation of each of the preparations, against the data obtained for the given constant. Direct extrapolation of the curve to the point where $\Delta t$ equals zero gives the constant corresponding to the pure substance or azeotropic mixture.

The determination of the boiling point of iso-amyl alcohol by W. Swietoslawski's comparative method[2] may serve as one example of such a correlation. In Table 1 there are listed: number of the fraction, the difference $\Delta t$, the degree of purity on W. Swietoslawski's scale[2], and the normal boiling point of each of the samples investigated.

Table 1.

| No. | $\Delta t$ | d.p. | b.p. |
|---|---|---|---|
| 1 | 0·032 | III | 131·067 |
| 2 | 0·019 | IV | 131·450 |
| 3 | 0·005 | V | 131·779 |
| 4 | 0·002 | V | 131·802 |

The boiling point of pure iso-amyl alcohol obtained by extrapolation of these data is 131·806° C.

The precise determination of density by means of the twin pycnometer method[3] furnishes another example of measurements which may be correlated with $\Delta t$ to obtain the densities of pure liquids. In Table 2 the densities of two fractions of *n*-propyl acetate are given, together with the corresponding values of $\Delta t$ and degree of purity. The density of pure *n*-propyl acetate obtained by extrapolation to $\Delta t = 0$ is $0{\cdot}88299_5$ gm./cm.$^3$ at 25° C.

Table 2.

| $\Delta t$ | d.p. | $d$(gm./cm.$^3$ at 25° C.) |
|---|---|---|
| 0·011 | IV | 0·882832 |
| 0·004 | V | 0·882939 |

It is worth noting that as the degree of purity of the substance investigated becomes higher, the change in the property measured becomes more nearly linear with $\Delta t$, thus permitting a reliable extrapolation to $\Delta t = 0$. Details will be published elsewhere.

M. WOJCIECHOWSKI.
(Guest Worker, Polytechnic Institute, Warsaw.)
EDGAR R. SMITH.
National Bureau of Standards,
U.S. Department of Commerce,
Washington, D.C.
April 30.

[1] W. Swietoslawski, *J. Phys. Chem.*, 38, 1169 (1935); IX Con. Inter. Quimica, Madrid, 1934, 13; *Roczniki Chem.*, 13, 176, 227 (1933); *Z. phys. Chem.*, A, 160, 257 (1932).
[2] *J. chim. phys.*, 27, 496 (1930).
[3] E. R. Smith and M. Wojciechowski, *Bull. intern. acad. Polonaise*, A, 1936.

## Metabolism of Cartilage

IT has been found by means of Warburg's manometric method that the metabolism of cartilage is entirely anærobic; it splits glucose to form lactic acid at a rate of about 0·2 c.mm. carbon dioxide

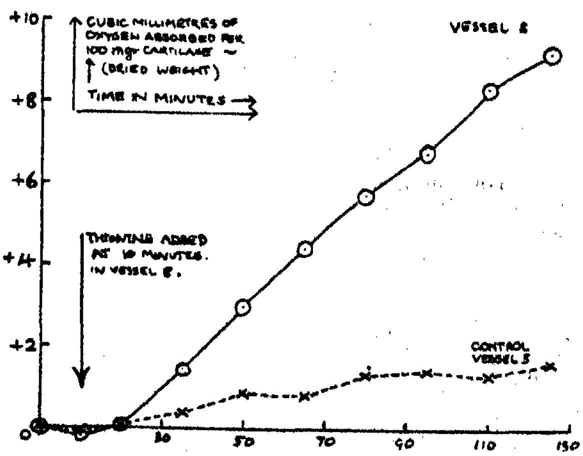



FIG. 1. Diagram showing oxygen uptake of cartilage with addition of dyestuff.

(produced from bicarbonate solution) per mgm. dry weight per hour, that is, about a tenth the rate of nearly related connective tissues forming the synovial villi, and a fiftieth the rate of the choroid plexus[1]. By means of cell counts and corrections for specific gravity and drying, it has been shown that this glycolysis is essentially of the same order per cell as in most other adult tissues. This glycolysis is the

same whether measured under ærobic or anærobic conditions. Rabbit cartilage was kept for a fortnight under aseptic anærobic conditions in bicarbonate Ringer solution with glucose, and its glycolysis measured throughout. At the end of the experiment it had only fallen to 0·09 from an initial $Q_G^{N_2}$ (c.mm. carbon dioxide per mgm. dry weight per hour in nitrogen) of 0·34.

There is no oxygen uptake that can be measured certainly by this method; if it exists, the $Q_{O_2}$ (c.mm. oxygen consumed per mgm. dry weight per hour) must be at most 0·01, and probably below 0·005. With methylene blue, however, an immediate large increase in oxygen uptake occurs, paralleled only by the similar behaviour described by Harrop and Barron[2] of non-nucleated mammalian red corpuscles. The $Q_{O_2}$ rises from an average of $-0·003$ (nine experiments) before, to an average, using the same slices, after addition of dye, of $-0·065$—a twenty-fold increase.

E. G. L. BYWATERS.
Courtauld Institute of Biochemistry,
Middlesex Hospital,
London, W.1.

[1] Krebs, *Tab. Biol. Period.*, 3, 209 (1933).
[2] Harrop and Barron, *J. Exp. Med.*, 48, 207 (1928).

## Oxide Layer on a Polished Copper Surface

THE application of electron diffraction to the problem of the structure of polished metal surfaces has greatly extended the knowledge gained from microscopical methods. In general, in the course of polishing, the rings of the electron diffraction pattern become blurred until they run into two broad haloes. As these changes may be explained by assuming that the metal crystals become smaller and smaller as the polishing progresses, the above-mentioned results are strongly in favour of Beilby's supposition that the topmost layer of highly polished metal is amorphous[1].

There is, however, considerable difficulty in accounting for the fact that the haloes have been found to be practically the same for all metals. They correspond to the spacings 2·25 A., and 1·28 A. ± 5 per cent respectively. This apparent uniformity could scarcely be expected. If we assume the polish layer to be composed of very small crystals, the radius of the haloes should depend on the lattice constants, while if the layer be completely amorphous it would be the atomic volume which should govern their size.

As the majority of the metals investigated are known to be easily oxidisable, it was decided to examine how far these difficulties might be due to the formation of an oxide film on the surface in the course of polishing. After having obtained results concordant with those of other authors for copper polished in the usual way with wet rouge, in air, I polished a specimen under the surface of benzene. This gave haloes of quite different size corresponding to spacings of 1·91 A. and 1·16 A. As polishing under pentane yielded the same result, it seemed likely that the pattern commonly attributed to polished copper is actually due to the oxide. To make sure, the specimen which had been polished under benzene was left in the air and the changes in the pattern were traced by taking pictures every few hours. It was possible to follow the gradual decay of the original haloes and gradual appearance of the pattern corresponding to the spacings 2·24 A. and 1·28 A. The last pattern, which is the one obtained after polishing in air, is thus clearly due to an oxide.

Whereas in the pattern obtained in the absence of air the inner halo may be interpreted as the effect of degeneration of the (111) and (200) rings of copper, and the outer one of the (220), (311) and (222) rings, the haloes obtained in air occur exactly in places where one may expect maxima of intensity after blurring of the corresponding rings of cuprous oxide, the cube side of copper being 3·61 A. and of $Cu_2O$ 4·25 A.

Many of the properties of a polished copper surface have recently been found to differ from those of a polycrystalline one[1]. As usually no special precautions against oxidation are observed during polishing, an interesting question arises as to how far these differences are to be attributed to the change of the physical state of the surface, and how far to change of chemical composition.

The investigation is being extended to other metals, as it is known that many metals which have themselves different crystalline structures, such as iron and nickel, have face-centred cubic oxides with a cube-side differing from that of $Cu_2O$ by only a few per cent. This fact may be partly responsible for the apparent uniformity of size of the haloes.

S. DOBINSKI.
Imperial College of Science
and Technology,
London, S.W.7.
May 12.

For references see G. I. Finch and A. G. Quarrell, NATURE, 137, 516 (1936).

## Electrolytes and a General Phenomenon in Tissue Cells

THE starting point of the present experiments was the assumption that the practically undiffusible particles of protoplasm are charged by the *per se* diffusible electrolytes with the formation of a double layer, and are maintained thereby in a dispersed state. If this be the case, then there must exist a certain equilibrium between the electrolytes, which build up the double layer on the particles of the protoplasm, and the electrolytes in the surrounding medium.

It must also be considered that this might concern thermodynamically a Donnan equilibrium—since the latter exists independently of the way in which the diffusible ions are adsorbed on the non-diffusible particles. In this case, if the salt ion contents of the outside liquid are diminished to nearly zero, then all the salt ions, as is well known, travel to the outside liquid.

If the above reasoning is valid, then it must be expected that if one makes the medium outside the tissue cells nearly free from electrolytes, the salt ions will travel to the outside liquid. Consequently a discharge, and a coagulation of the non-diffusible and discharged particles of protoplasm, would be expected.

It has been possible in the case of tissue cells cultivated in liquid media to make the liquid outside the cells nearly free from electrolytes and to produce thereby a discharge (most active Brownian movement in the protoplasm as a sign of a minimum of viscosity; obviously advancing aggregation of the particles of the protoplasm). The following results have been obtained:

(1) If tissue cells are brought from their liquid culture medium, after several washings, into a medium free from electrolytes, then within a few seconds the following phenomena, consisting of three main effects, take place: (*a*) an assumption of globular form by the cells; (*b*) the appearance of a vivid Brownian movement of the granules and vacuoles in the cytoplasm, as a sign of a maximal reduction of the viscosity in consequence of a discharge with simultaneous increasing absorption of water; (*c*) a process of slow coagulation in the cytoplasm, which manifests itself in the appearance of new particles in vivid Brownian movement, which continuously increase in size. The gradual multiplication and increase of the particles is best seen with dark field illumination, but the vivid Brownian movement is also well seen with direct illumination.

(2) In some of the cells which have become globular, there occurs a bursting of the cell, with extrusion of liquid contents containing particles in Brownian movement (analogous to hypotonic hæmolysis with extrusion of hæmoglobin). Sometimes the torn parts adhere together again after diminution of the interior pressure.

(3) The presence of non-electrolytes in the medium ($n/36-n/12$ dextrose: $n/5-n/1$ urea) does not hinder the appearance of the phenomena described, but naturally reduces the activity of the Brownian movement in the cytoplasm.

(4) The phenomena described are reversible. The reversal can be produced after several minutes by means of Ringer solution, $n/10$ sodium chloride, or $n/10$ sodium bromide. The cells regain their former shape extremely quickly, with immediate stoppage of the Brownian movement in the cytoplasm. The cells then show normal vital staining.

(5) The phenomena can only be produced with living and not with dead cells. Failure is a sure sign of cell death.

The results of these experiments prove the justness of the above assumptions. Furthermore, they show that hypotonic hæmolysis is only a special case of a general phenomenon in tissue cells. They reveal, furthermore, a fundamental property of tissue cells in which the salt ions of the tissue liquid participate decisively in the maintenance of the particle charge of the protoplasm.

H. GROSSFELD.

Anatomical Institute,
Turin.

## A Syndrome produced by Diverse Nocuous Agents

EXPERIMENTS on rats show that if the organism is severely damaged by acute non-specific nocuous agents such as exposure to cold, surgical injury, production of spinal shock (transcision of the cord), excessive muscular exercise, or intoxications with sublethal doses of diverse drugs (adrenaline, atropine, morphine, formaldehyde, etc.), a typical syndrome appears, the symptoms of which are independent of the nature of the damaging agent or the pharmacological type of the drug employed, and represent rather a response to damage as such.

This syndrome develops in three stages: during the first stage, 6–48 hours after the initial injury, one observes rapid decrease in size of the thymus, spleen, lymph glands and liver; disappearance of fat tissue; œdema formation, especially in the thymus and loose retroperitoneal connective tissue; accumulation of pleural and peritoneal transudate; loss of muscular tone; fall of body temperature; formation of acute erosions in the digestive tract, particularly in the stomach, small intestine and appendix; loss of cortical lipoids and chromaffin substance from the adrenals; and sometimes hyperæmia of the skin, exophthalmos, increased lachrymation and salivation. In particularly severe cases, focal necrosis of the liver and dense clouding of the crystalline lens are observed.

In the second stage, beginning 48 hours after the injury, the adrenals are greatly enlarged but regain their lipoid granules, while the medullary chromaffin cells show vacuolization; the œdema begins to disappear; numerous basophiles appear in the pituitary; the thyroid shows a tendency towards hyperplasia (more marked in the guinea pig); general body growth ceases and the gonads become atrophic; in lactating animals, milk secretion stops. It would seem that the anterior pituitary ceases production of growth and gonadotropic hormones and prolactin in favour of increased elaboration of thyrotropic and adrenotropic principles, which may be regarded as more urgently needed in such emergencies.

If the treatment be continued with relatively small doses of the drug or relatively slight injuries, the animals will build up such resistance that in the later part of the second stage the appearance and function of their organs returns practically to normal; but with further continued treatment, after a period of one to three months (depending on the severity of the damaging agent), the animals lose their resistance and succumb with symptoms similar to those seen in the first stage, this phase of exhaustion being regarded as the third stage of the syndrome.

We consider the first stage to be the expression of a general alarm of the organism when suddenly confronted with a critical situation, and therefore term it the 'general alarm reaction'. Since the syndrome as a whole seems to represent a generalised effort of the organism to adapt itself to new conditions, it might be termed the 'general adaptation syndrome'. It might be compared to other general defence reactions such as inflammation or the formation of immune bodies. The symptoms of the alarm reaction are very similar to those of histamine toxicosis or of surgical or anaphylactic shock; it is therefore not unlikely that an essential part in the initiation of the syndrome is the liberation of large quantities of histamine or some similar substance, which may be released from the tissues either mechanically in surgical injury, or by other means in other cases. It seems to us that more or less pronounced forms of this three-stage reaction represent the usual response of the organism to stimuli such as temperature changes, drugs, muscular exercise, etc., to which habituation or inurement can occur.

HANS SELYE.

Department of Biochemistry,
McGill University,
Montreal, Canada.
May 18.

## Estimation of Fatty Acids in Organic Mixtures

FOR the determination of the volatile fatty acids in cheese, it is usual to subject the acidified cheese mush to a normal steam distillation at constant volume. In this laboratory, it is the custom to collect a volume of distillate equal to three times the volume of the liquid in the distillation flask, and

to use this for further estimations of the individual acids.

The study of the rate of recovery of various volatile acids, added in known quantities to the cheese mush, led to doubt as to whether this method of distillation resulted in the complete extraction of the volatile acids (especially the higher members of the series) from the cheese. It appeared that the higher acids were to some extent held back by the constituents of the cheese, and did not therefore distil over at the rate suggested by Dyer's figures[1].

This view was strengthened by a series of experiments in which several acids were distilled from water, and a mixture of fresh, washed butter fat and water. It was evident that there was retention of some of these acids by the butter fat, very marked for lauric acid and high for caprylic, but decreasing through caproic to butyric and the lower members of the series, in which no retention was demonstrated.

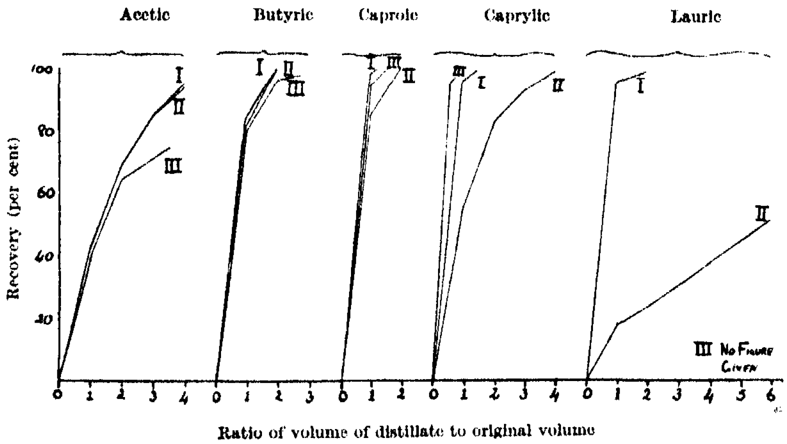



FIG. 1. Fatty acid recovery by steam distillation: I, acid distilled from distilled water; II, acid distilled from pure butter fat; III, distillation figure given by Dyer.

It was found, however, that although the rate of distillation of the higher acids was retarded by the presence of butter fat, almost complete recovery could be effected if the steam distillations were continued for a sufficiently long period. For the acids up to and including caprylic, more than 90 per cent of the added acid could be recovered by collecting a distillate of three times the original volume. For lauric acid, on the other hand, only 50 per cent was recovered even after collecting six times the original volume (cf. Fig. 1).

If the rate of distillation of these acids from a cheese mush is comparable with that from a mixture of butter fat and water, then the practice of collecting a distillate of three times the original volume would allow an estimate of the distribution of volatile acids in cheese which would be sufficiently accurate for many purposes. It is suspected, however, that a still greater retention occurs in the cheese mush, and the influence of cheese fat (as distinct from butter fat) and the protein and salt mixtures of cheese is being examined in an effort to elucidate this question.

E. R. HISCOX.
J. HARRISON.
National Institute for Research in Dairying,
Shinfield, Nr. Reading, Berks.
May 25.

[1] D. C. Dyer, *J. Biol. Chem.*, **28**, 445 (1916–17).

## The Stock of Antarctic Blue Whales

DURING the current investigations into the conditions of Southern whaling, I have had occasion to consult the publications[1] of the Norwegian Whaling Bureau, in which the catch statistics given in "International Whaling Statistics" have been amplified and to some extent analysed. From these data I have calculated the average length of female Blue whales taken from 1930 to 1935. The results are shown in the following table.

| Season | No. of whales considered | Average length (ft.) |
|---|---|---|
| 1930–31 | 4,532 | 82·36 |
| 1931–32 | close season | — — |
| 1932–33 | 5,285 | 81·97 |
| 1933–34 | 6,487 | 81·85 |
| 1934–35 | 7,253 | 79·88 |

A slight annual decrease in length up to 1933–34 is followed by a sharp drop of nearly two feet in 1934–35. Blue females become sexually mature at about 78 ft., when they are approximately two years old. They arrive at maturity in the southern winter, and are found in the Antarctic the following summer with an average length of 80 ft. Pairing in July may result in pregnancy which lasts for ten months[2].

Blue females taken in 1934–35 were, therefore, on the average, killed at the outset of their reproductive career. The consequences of continued intensive killing need scarcely be emphasized.

Average lengths were shown in the Norwegian publications, but the data had been divided, and average lengths were given for immature and adult whales separately. The constancy of the averages from season to season was invoked as evidence that undue depletion of the stock is not yet taking place, but since no account was taken of the rapidly mounting percentage of immature whales in the catch the results are liable to be misleading.

ALEC H. LAURIE.
"Discovery" Investigations,
52 Queen Anne's Chambers,
London, S.W.1.
June 3.

[1] Hjort, Lie and Ruud, "Hvalrådets Skrifter", **3**, **8**, **9**, **12**.
[2] Mackintosh and Wheeler, "Discovery Reports", **1**, pp. 468–9 (1929).

## The Manatee of St. Helena

IN NATURE of March 17, 1934, p. 417, Prof. T. Mortensen quotes Dampier's reasons for refusing to believe in the existence of the sea-cow in St. Helena. The bibliography on the subject appears to be far from complete; but fortunately records by two eye-witnesses are available.

Probably the best account of the St. Helena manatee will be found in Barnes's "Tour of St. Helena" (Richardson, London, 1817, pp. 116 and 117), where a detailed description of the animal is quoted from the manuscript of Lieut. Thomas Leech, "written many years ago". The Leechs were a well-known and highly respectable Island family, and Thomas

Leech, who affirmed that the sea-cow was really a sea lion, is mentioned in Brooke's "History of St. Helena" (1824 ed., p. 51), as one "who by his unwearied pursuits in historical research, and his surprisingly retentive memory had acquired a great degree of general information".

There is another very important reference in Dr. Walter Henry's "Events of a Military Life" (2nd ed., Pickering, London, 1843, vol. 2, pp. 66 and 67), which is as follows :

"We had sea-cows at St. Helena, the Trichechus Dugong, but they were not common. When shooting near Buttermilk Point with another officer one calm evening, we stumbled on one lying on a low rock close to the water's edge, and a hideous ugly brute it was, shaped like a large calf, with bright green eyes as big as saucers. We only caught a glimpse of it for a few seconds, for as soon as it noticed us, it jumped into the sea, in the most awkward and sprawling manner."

Dr. Henry, whose book is well known to Napoleonic students, was an alert and accurate observer of current events, who later reached high rank in the Army Medical Service and died in 1860. His observations were made between 1817 and 1821 ; probably in 1819.

It may be a convenience to students if I recapitulate the references to be found to sea-cows in the Public Records of Jamestown :

| | |
|---|---|
| 1679, January 27. | First use of the name Manatee Bay. |
| 1682, August 28. | Several sea-cows caught. |
| 1690, March 20. | A very small sea-cow killed. |
| 1691, May 11 (a month before Dampier's visit). | Sea-cow on shore to Windward. |
| 1716, August 29. | 400 lb. ambergris found in Manatee Bay. |
| 1739, September 11. | A sea-cow killed. |

Burnham's sea-cow of 1810 referred to by Lydekker and Mortensen, I am unable to trace as recorded in the Public Records ; but the latter quotes Janisch's confirmation of it to be found in "Scraps from Records" (Government Printer, Jamestown, 1880, to accompany the St. Helena Almanack of that year).

G. C. KITCHING.

The Castle,
St. Helena.
April 18.

## A Case of 50 per cent Crossing-over in the Male *Drosophila*

WITH the view of synthesising a double recessive black-vestigial stock of *Drosophila melanogaster*, Dr. G. Eloff[1] made a cross of black and vestigial, both of which are contained in the second chromosome. The $F_2$ generation, to his surprise, contained many *b vg* flies. To solve the question, the $F_1$ males were mated with double recessive females (*b vg*), when an independent segregation of black and vestigial was found. He applied the fact to the $F_2$ data to calculate the crossing-over value between *b* and *vg* in the female, and estimated it to be 17·8 per cent. The value is close to the standard value of 17·0 per cent (18·5 per cent, according to the recent census). For his 50 per cent crossing-over in the male, he writes : "Some other explanation (for example, of chromosomal mutation) must be offered".

In my opinion, Dr. Eloff used by mistake the other mutant, ebony for example, that appears in another chromosome. If so, the black body colour should be inherited independently with vestigial, and it would be quite the natural thing that there should be a 50 per cent crossing-over in the male. According to my understanding, his $F_2$ data seem to be nothing but the result of an independent segregation, although deviation was considerable.

DAIGORO MORIWAKI.

Furitsu Koto-Gakko,
Biological Institute,
Meguro, Tokyo.
March 6.

[1] G. Eloff, NATURE, 137, 151 (1936).

SINCE the appearance of my letter in NATURE of January 25, Prof. Tammes of Groningen has written to me as follows : "Gottschewski (of Berlin-Dahlem) is of opinion that the 'black' which you used was probably not the normal black but the so-called 'black Kreidel Holland' which is the same as sooty . . ."

The stock which I received from Groningen was only labelled 'black'. But it probably was a 'sooty' culture from stocks used by Dr. van Herwerden (and her student Kreidel), who got their cultures from America and Berlin-Dahlem. For some reason which is not clear to me at present, this 'sooty' stock was either labelled "black Kreidel Holland" or "black".

In order to make sure that it was the 'black' culture which was responsible for the independent segregation obtained, I this time made use of a vestigial stock from Berlin-Dahlem. The class representations of two series of repulsion back-crosses, the $F_2$ of which I have just finished counting, were as follows :

$F_1$ ♂ back-crosses : 204 $BV$, 235 $bV$, 194 $Bv$, 171 $bv$

$$\frac{BV + bv}{BV + bV + Bv + bv} = \text{approx. } 46 \cdot 6 \text{ per cent.}$$

$F_1$ ♀ back-crosses : 701 $BV$, 839 $bV$, 670 $Bv$, 698 $bv$

$$\frac{BV + bv}{BV + bV + Bv + bv} = \text{approx. } 48 \cdot 1 \text{ per cent.}$$

As the data refer to repulsion crosses only, the unequal representation of the classes may be explained by (1) difficult separation of $bV$ and $BV$ phenotypes in some experiments, with the result that $BV$ phenotypes may be included in class $bv$ ; (2) poorer viability of classes homozygous for vestigial, namely, $Bv$ and $bv$. Making allowance for these disturbing factors, it is quite possible that the correct percentage will be 50.

I am satisfied, therefore, that the stock I have used and which was labelled "black" may have been "sooty", so that the results must of necessity show independent segregation.

I regret the misleading results arrived at due to erroneous labelling of the stock, and I wish to thank Mr. Moriwaki for his comment.

G. ELOFF.

Department of Zoology,
University of the Witwatersrand,
Johannesburg.
April 22.

## Suggested Cases for Suspension of Rules of Nomenclature

ATTENTION of the zoological profession is invited to the fact that request for the "Suspension of the Rules" has been made in the following cases, on the ground that "the strict application of the Règles will clearly result in greater confusion than uniformity".

According to procedure, one year's notice is hereby published "making it possible for zoologists, particularly specialists in the group in question, to present arguments for or against the suspension under consideration".

Note A.—Suspend rules. Note B.—Insert in Official List with the type as given in parentheses.

COELENTERATA.—*Monograptus* Geinitz, 1852 (*priodon*); A, B. *Retiolites* Barrande, 1850 (*geinitzianus*); A, B. *Graptolithus* Linn., 1768, to be suppressed; A.

ECHINODERMATA.—*Luidia* Forbes, 1839 (*fragilissima*); A, B.

NEMATODA.—*Anguina* Scopoli, 1777 (*Vibrio tritici*), to be suppressed; A.

CRUSTACEA.—*Squilla* Fabricius, 1787 (*mantis*); A, B.

INSECTA.—The so-called "Erlangen List" of 1801 to be suppressed.

ORTHOPTERA.—*Locusta* Linn., 1758 (*Gryllus Locusta migratorius* Linn., 1758); *Phaneroptera* Serville, 1831 (*Gryllus falcatus* Poda, 1761); A. B.

HYMENOPTERA.—*Cimbex* Olivier, 1790 (*Tenthredo lutea* Linn., 1758); A, B. *Crabro* Fabricius, 1775 (*Sphex cribraria* Linn., 1767); A, B. *Lasius* Fabricius, 1805 (*Formica nigra* Linn., 1758); A, B. *Anthophora* Latreille, 1803 (*Apis pilipes* Fabr., 1775); A, B. *Ichneumon* Linn., 1758 (*Ichneumon extensorius* Linn., 1758); A, B. *Pimpla* Fabr., 1804 (*Ichneumon instigator* Fabr., 1793); A, B. *Ephialtes* Gravenhorst, 1829 (*Ichneumon manifestator* Linn., 1758); A, B. *Bracon* Fabr., 1805 (*Bracon minutator* Fabr., 1798); A, B. *Pompilus* Fabr., 1798 (*Pompilus pulcher* Fabr., 1798); A, B. *Bethylus* Latreille, 1802 (*Omalus fuscicornis* Jurine, 1807); A, B. *Prosopis* Jurine, 1807 (*Sphex signator* Panzer, [1798]); A, B. *Ceraphron* Jurine, 1807 (*Ceraphron sulcatus* Jurine, 1807); A, B. *Torymus* Dalman, 1820 (*Ichneumon bedeguaris* Linn., 1758); A, B. *Proctotrupes* Latreille, 1796 (*Proctotrupes brevipennis* Latreille, 1802); A, B. *Sphex* Linn., 1758 (*Sphex flavipennis* Fabr., 1793); A, B. *Ammophila* Kirby, 1798 (*Sphex sabulosa* Linn., 1758); A, B.

LEPIDOPTERA.—In interpreting the generic names assigned by Freyer in his "Neuere Beiträge zur Schmetterlingskunde" to the species there described, each species is to be regarded as having been described by Freyer as belonging to the genus cited by him at the head of each description and not to the genus with which he actually associated the specific name. For example, Freyer described, under the genus *Hipparchia* Fabricius, a species to which he gave the specific name *eriphyle*, and which he proceeded to name *Papilio eriphyle* Freyer. Freyer is to be deemed to have described this species under the name *Hipparchia eriphyle*, and not under the name *Papilio eriphyle*. A.

*Potamis* Hübner, *Rusticus* Hübner, and *Mancipium* Hübner to be suppressed in favour of *Morpho* Fabr., *Helicopis* Fabr., and *Pontia* Fabr.; A.

LEPIDOPTERA (RHOPALOCERA).—*Euploea* Fabr., 1807 (*Papilio corus* Fabr., 1793); A, B. *Satyrus* Latreille, 1810 (*Papilio actaea* Esper, [1780]); A, B. *Argynnis* Fabr., 1807 (*Papilio paphia* Linn., 1758); A, B. *Vanessa* Fabr., 1807 (*Papilio atalanta* Linn., 1758); A, B. *Euthalia* Hübner, [1823] (*Papilio lubentina* Cramer, 1777); A, B. *Nymphidium* Fabr., 1807 (*Papilio caricae* Linn., 1758); A, B. *Colias* Fabr., 1807 (*Papilio hyale* Linn., 1758); A, B.

Species in parentheses are to be declared the types *Lycaeides* Hübner, [1823] (*Papilio argyrognomon* Bergstrasser, 1779); A. *Agriades* Hübner, [1823] (*Papilio glandon* Prunner, 1798); A. *Polyommatus* Latreille, 1804 (*Papilio icarus* Rottemburg, 1775); A. *Euchloë* Hübner, [1823] (*Euchloë ausonia* Hübner, var. *esperi* Kirby, 1871). *Princeps* Hübner, [1807] and *Orpheides* Hübner, [1823] (*Papilio demodocus* Esper, 1798). *Carcharodus* Hübner, [1823] and *Spilothyrus* Duponchel, 1835 (*Papilio fritillarius* Poda, 1761); A.

C. W. STILES,
Acting Secretary,
International Commission
on Zoological Nomenclature.
U.S. National Museum,
Washington, D.C.
May 1.

## Effect of Oxygen on the Auroral Afterglow

DURING the past year, I have been studying the effect of oxygen on the auroral afterglow in nitrogen. This afterglow is the one the spectrum of which corresponds to the nitrogen part of the auroral spectrum. Attention has been directed elsewhere[1] to some of the more general results of these experiments, but in view of the recent communication by Vegard and Tønsberg[2] on the difference between the spectra of sunlit and ordinary auroras, one aspect of my experiments seems worth special mention here.

Oxygen is introduced into the tube until the blue-green afterglow with continuous spectrum appears. As the tube is allowed to run, the oxygen slowly disappears and the spectrum of the afterglow undergoes some striking changes. The stage of the afterglow which follows the initial blue-green continuous stage is one in which the glow consists of a blue-green background that fills the entire bulb, possesses a banded spectrum and lasts about ten seconds. Superposed on this blue-green glow is an orange-red flash of shorter duration and greater intensity than the background glow. This flash is confined to the centre of the bulb, and its spectrum consists of first positive bands of $N_2$ and some relatively weak first-negative bands.

Visual examination as well as photographic reproduction of the spectrum shows that the effect of the oxygen is to enhance the first-positive bands relative to the first-negative group. This phenomenon agrees very well with the results of Vegard and Tønsberg on sunlit auroras. The blue-green continuous glow is generally regarded as resulting from the reaction between ozone and nitric oxide. There is therefore probably some ozone present in the orange-red flash stage that follows when the oxygen concentration is slightly reduced.

It is of interest to note that the green auroral line is weaker in this stage of the glow than one would expect, and this also is in agreement with Vegard and Tønsberg's results. It is believed that further study of this orange-red flash will reveal detailed agreement between the laboratory phenomenon here described and the sunlit auroras.

JOSEPH KAPLAN.
University of California
at Los Angeles.
May 21.

[1] Kaplan, *Trans. Amer. Geophys. Union*, April, 1936.
[2] Vegard and Tønsberg, NATURE, 137, 778 (1936).

## Ground State Vibrational Frequencies

A STUDY of the ground state vibrational frequencies of diatomic molecules in relation to the Periodic Table has shown that the arithmetic mean $\omega_m$ of the vibrational frequencies of the two elementary molecules $A_2$ and $B_2$ which belong to the same Periodic Group is approximately equal to the frequency of the compound molecule $AB$. All the relevant data are collected in the accompanying table.

| Group 1 | | | Group 5 | | | Group 6 | | | Group 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mol. | $\omega$ | $\omega_m$ | Mol. | $\omega$ | $\omega_m$ | Mol. | $\omega$ | $\omega_m$ | Mol. | $\omega$ | $\omega_m$ |
| $Li_2$ | 352 | | $N_2$ | 2360 | | $O_2$ | 1568 | | $Cl_2$ | 565 | |
| $Na_2$ | 159 | | $P_2$ | 778 | | $S_2$ | 727 | | $Br_2$ | 324 | |
| $K_2$ | 93 | | $As_2$ | 432 | | $Se_2$ | 388 | | $I_2$ | 214 | |
| $Rb_2$ | 58 | | $Sb_2$ | 268 | | SO | 1124 | 1148 | ICl | 385 | 389 |
| $Cs_2$ | 41 | | $Bi_2$ | 173 | | SeO[5] | (910) | 978 | IBr | 267 | 269 |
| LiK | (207) | 223 | PN[2] | 1337 | 1569 | | | | BrCl | (440) | 445 |
| LiRb | (185) | 205 | AsN[3] | 1063 | 1396 | | | | | | |
| LiCs | (170) | 196 | BiSb[4] | 220 | 221 | | | | | | |
| NaK | 123 | 126 | | | | | | | | | |
| NaRb[1] | 107 | 109 | | | | | | | | | |
| NaCs | 96 | 90 | | | | | | | | | |

Bracketed values are uncertain.

In Group 5 the BiSb molecule conforms to this rule, whereas the PN and AsN molecules do not. The $\omega$ value of the former molecule definitely refers to the ground state, as it is derived from absorption measurements, but there is no such certainty in the case of the latter molecules as their $\omega$ values are derived from emission spectra. It is suggested, therefore, that these discrepancies are due to the fact that the $\omega$ values presented here for PN and AsN do not refer to their ground states but to excited states. If this is so, it is probable that the actual ground state frequencies will be of the order of 1570 cm.$^{-1}$ and 1400 cm.$^{-1}$ respectively.

This subject will be discussed in greater detail in a future publication.

H. G. HOWELL.

Physics Department,
Armstrong College,
Newcastle-on-Tyne.
May 16.

[1] Kusch, *Phys. Rev.*, **49**, 218 (1936).
[2] Curry, L. Herzberg and G. Herzberg, *Z. Phys.*, **86**, 348 (1933).
[3] Spinks, *Z. Phys.*, **88**, 511 (1934).
[4] Nakamura and Shidei, *Jap. J. Phys.*, **10**, 11 (1935).
[5] Asundi, Jan-Khan and Samuel, NATURE, **136**, 642 (1935).
Remaining data have been obtained from Jevon's "Report on Band Spectra" (Physical Society, 1932).

## A Second Sheath near the Cathode of an Arc Discharge

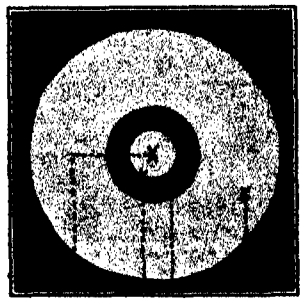
IN the course of some investigations on arc discharges with oxide-coated cathodes in rare gases, a new dark sheath with a sharp boundary was seen between the well-known Langmuir double space-charge sheath on the cathode and the light of the arc plasma. Fig. 1 shows diagrammatically (*a*) the cylindrical (indirectly heated) barium–strontium oxide coated cathode (viewed end-on), with (*b*) the well-known absolutely dark space-charge sheath, a few tenths of a millimetre in width and concentric with it, and (*c*) the almost dark sheath a few millimetres wide, followed by (*d*) the light of the plasma.

The thickness of this new sheath (*c*) varies approximately inversely with the square root of the current density and only slightly with the gas pressure. At low current density, for example, 0·1 amp. per cm.$^2$, the sheath becomes very indistinct. This dark sheath is only visible in a definite pressure range:

| | | | | | | |
|---|---|---|---|---|---|---|
| In helium | between | 3 | and | 0·7 | mm. | rather indistinct |
| ,, neon + (0·1–1 per cent argon) | ,, | 0·6 | ,, | 0·2 | ,, | sharp |
| ,, argon | ,, | 0·2 | ,, | 0·02 | ,, | ,, |
| ,, krypton | ,, | 0·14 | ,, | 0·01 | ,, | ,, |
| ,, xenon | ,, | 0·08 | ,, | 0·008 | ,, | ,, |
| ,, mercury vapour | ,, | 0·03 (60° C.) | and | 0·007 (40° C.) | | sharp. |

In pure neon the sheath was barely visible. In argon, krypton and xenon the colour changes at the lower pressure limit mentioned above and at lower pressures a sheath is observed, which is brighter than the arc plasma, with almost the same dimensions as the dark sheath. At still lower pressures it disappears. In hydrogen, at 0·5 mm., a bright sheath is observed round the cathode with about the same thickness as in the case of the noble gases. Below 0·1 mm. we can see in hydrogen concentric with the dark space-charge sheath a bright and an almost dark sheath followed by the light of the discharge plasma (very distinct at 0·005 mm).

These last phenomena were also observed in argon (though very indistinct) at such a low pressure that the bright sheath had disappeared.



a b c d

FIG. 1. Diagram of glow from an oxide-coated cathode, in argon at 0·05 mm. pressure, current 2·0 amp., diameter of cathode 4 mm., emitting surface 2·9 sq. cm.

A more extensive report will be published in the Dutch journal *Physica*.

N. WARMOLTZ.

Natuurkundig Laboratorium
der N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Holland.
May 18.

## Parallel-Plane Diode Magnetron

IN the discussion on a paper[1] by W. E. Benham on "Electronic Theory and the Magnetron Oscillator", it is remarked that although oscillations should be expected from plane diodes with magnetic field[2], no experimental evidence had been brought forward to support this.

We have constructed a plane diode of the Müller[3] type consisting of a plane indirectly heated oxide-coated cathode, 17 mm. in diameter, and an anode the two plane plates of which were approximately 15 mm. in diameter, situated on either side and at 1 mm. distance from the cathode. The anode plates provide the capacitance of the oscillating circuit, and the conductor joining these two plates (assumed

for calculation in this case to be a ring of 21 mm. in diameter), provides the inductance. The anode current is fed to this ring at a voltage node. The arrangement can be seen from Fig. 1.

It was hoped with this valve to obtain diode oscillations[2] of the order of 30 cm. without a magnetic field, but having failed to detect any, owing perhaps to the lack of exact symmetry in the apparatus, a magnetic field was applied parallel to the electrodes. Weak oscillations could be detected with a Lecher wire system coupled capacitatively to the valve, together with rectifier and sensitive galvanometer.

FIG. 1. Parallel-plane diode magnetron.

Until a further valve is built, little more can be said than :

(1) the oscillations occur where the magnetic field starts to cause a reduction in the anode current,

(2) the oscillation intensity falls off as the direction of the magnetic field is altered from that parallel to the electrodes, to that perpendicular to the plane of the electrodes.

(3) the wave-length of the oscillations is of the order of that determined by the oscillating circuit (the anode plates plus connecting wire).

D. M. TOMBS.

Institut für Schwingungsforschung,
Franklinstrasse 1,
Berlin, N.W. 87.
May 12.

[1] W. E. Benham, *Proc. Phys. Soc.*, **47**, pt. 1, No. 258 (Jan. 1935).
[2] J. Müller, *Z. Hochfreq. und Elektroak.*, **46**, Heft 5 (Nov. 1935).
[3] J. Müller, *Z. Hochfreq. und Elektroak.*, **43**, Heft 5 (June 1934).

## Collisional Friction Frequency in the Ionosphere at Allahabad

APPLETON[1] has shown that for the ordinary ray the integrated absorption coefficient $k$ for absorption in the deviating region (that is, in the region where $\mu$ approaches zero) may be calculated from the following formula :

$$-2\int_{\mu=1}^{\mu=0} k\,dh = \ln \rho_0 = -\frac{\nu}{2c}\left(P_0' - P_0\right), \quad . \quad . \quad . \quad (1)$$

where $\nu$, the collisional friction frequency per electron per second, is assumed to be constant throughout the deviating region ; $\rho_0$ is the reflection coefficient for the ordinary ray ; $P'_0$ is the group path ; and $P_0$ is the optical path of the wave.

Late in the night after the magneto-ionic splitting has taken place and the ordinary ray has undergone much group retardation, we are justified in assuming that

$$\triangle (\ln \rho_0) = -\frac{\nu}{2c}\triangle (P_0') \quad . \quad . \quad . \quad (2)$$

Thus if we plot ln $\rho_0$ against the equivalent height $P_0'/2$, we should expect a straight line, the slope of which will give us the value of $\nu$. The observations made in this laboratory during last winter show the validity of formula (2) and give an average value of $\nu$ of $1{\cdot}2 \times 10^4$ per electron per second.

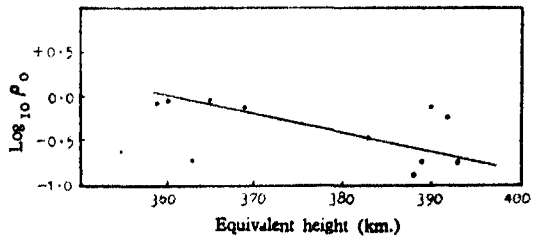



FIG. 1. $F$-layer reflections, March 1, 1936, time 0319-0402 I.S.T.

In Fig. 1, $\log_{10} \rho_0$ has been plotted against the equivalent height for reflections from the $F$-layer. $\nu$ comes out to be $1{\cdot}2 \times 10^4$ per electron per second.

The value of $\nu$ has also been determined by similar methods in England by Eckersley[2] and Farmer and Ratcliffe[3]. Eckersley has found $\nu = 3{\cdot}6 \times 10^3$ in the daytime for the $F$-region, while Farmer and Ratcliffe's night-time value of $\nu$ for the $F$-region is $2{\cdot}1 \times 10^3$ and the daytime value is $1{\cdot}2 \times 10^3$ per electron per second. Thus we see that the value found by us differs considerably from that found by workers in England. At present it is not possible to account for this difference, unless more data extending over a large period are available.

Further observations are being made and details will be published elsewhere.

G. R. TOSHNIWAL.
B. D. PANT.
R. R. BAJPAI.

Physical Laboratory,
University, Allahabad.
May 7.

[1] Appleton, NATURE, **122**, 879 (1928) ; **135**, 618 (1935).
[2] Eckersley, NATURE, **135**, 435 (1935).
[3] Farmer and Ratcliffe, *Proc. Roy. Soc.*, A, **151**, 370 (1935).

## Sensitivity of Photographic Plates in the Region $\lambda\lambda$ 2500–2100 A.

IT is well known that the sensitivity of an ordinary photographic emulsion begins to fall rapidly just below $\lambda$ 2500 A., and is very low at $\lambda$ 2100 A. This fall is due to the absorption of short-wave radiation by the gelatin of the emulsion. It is commonly stated[1] that higher sensitivity in this region may be obtained by greatly reducing the gelatin content of the emulsion, as in the Schumann plate, or by bathing an ordinary plate in a fluorescent substance which can

convert the short waves into radiation able to penetrate the gelatin.

Having had occasion recently to photograph spectra of low intensity in this region, we were surprised to find that better results could be obtained with ordinary plates than with plates recommended as having much higher ultra-violet sensitivity. We have therefore carried out some experiments with the view of clearing up this apparently anomalous behaviour.

The procedure was as follows. A heavy-current discharge tube, through which passed a slow stream of air, provided a steady source of the γ-bands of nitric oxide. These bands are characterised by strong, well-defined heads, with long branches slowly degraded in the direction of shorter wave-lengths. The range of intensity thus available makes this band system very suitable for comparison of plate characteristics in the ultra-violet. Using a Hilger $E2$ quartz spectrograph, identical sets of exposures in logarithmic steps were made on each plate under test. Ordinary plates (Imperial) were compared in this way with Schumann plates (Hilger and Agfa), special ultra-violet plates (Eastman and Agfa), $Q$-plates (Ilford), and Imperial plates treated with such common sensitisers as anthracene, sodium salicylate, vaseline and various mineral oils.

In most cases, especially when the source is weak, the spectroscopist wishes

(*a*) to obtain a measurable record of the spectrum with the least possible exposure, and

(*b*) to reproduce, as a range of perceptible density differences, the intensity differences present in the actual spectrum.

Our results show that

(*a'*) every plate tested, except the Ilford $Q2$ plate, gives less blackening for short exposures than does an ordinary plate. That is to say, an ordinary plate fulfils condition (*a*) better than the 'sensitised' plates, with this one exception.

(*b'*) the 'sensitised' plates are capable of showing more intensity contrast than ordinary plates, because they have a greater saturation density. This increased density, however, is obtained only by prolonging exposure beyond that which is needed to reach saturation with ordinary plates.

If, therefore, it is desired merely to detect a weak spectrum in this region, it is undesirable to use 'sensitised' plates. If, on the other hand, the source of radiation is intense, or short exposure time is not aimed at, these plates will give greater contrast and higher saturation density than ordinary ones.

It is perhaps also worth noting that considerable over-exposure in this region does not produce on an ordinary plate densities comparable with those attainable in the nearer ultra-violet or visible region. Apart altogether from considerations of fogging, excessive exposure is detrimental in that it smooths out what little intensity contrast is present in a correctly exposed plate. This is shown by the fact that, on an over-exposed plate, even such a spectrum as that of NO appears almost continuous.

A full account of the experiments will be published shortly.

A. HUNTER.
R. W. B. PEARSE.

Royal College of Science,
South Kensington,
London, S.W.7,
June 3.

[1] For example, Hopfield and Appleyard, *J. Opt. Soc. America*, **22**, 488 (1932). Weichmann, *Z. wiss. Phot.*, **34**, 140 (1935).

## Nova Lacertæ, 1936

SLIT spectra of the nova have been obtained at this Observatory on every night, with one exception, since the discovery was announced on June 19.

The most prominent feature in the spectra is the broad emission bands of the Balmer series of hydrogen, $H\alpha$ being particularly bright. The width of the $H\beta$ and $H\gamma$ emissions on the evening of June 22 was about 50 angstroms. These emissions are flanked on the side of shorter wave-length by rather weak absorption lines. The more displaced component of the two $H\gamma$ absorptions indicated a velocity of about $-1100$ km./sec. on the morning of June 20; this rose to about $-1900$ km./sec. by the evening of June 22.

Fe II, Ti II, Mg II, and Ca II are also represented by broad weak emission bands and displaced absorption lines. These absorption lines are weak and hazy, but the sharp interstellar $H$ and $K$ lines are strongly shown on a plate taken on the evening of June 22.

The general appearance of the spectrum is in sharp contrast with that of Nova Herculis, 1934, at a corresponding stage of development.

T. W. WORMELL.
J. C. DOBBIE.

Solar Physics Observatory,
Cambridge. June 26.

## The Background of the Galaxies

IN NATURE of May 30, M. Leontovski[1] shows that "To a most sensitive eye, the background of the galaxies would appear as a dark red." Since the irresolvable background consists of nebulæ receding with nearly the speed of light, the age of these nebulæ, as observed, reckoned in our own time-scale, must be approximately one half the present age of our own surroundings; that is, if $t$ is the conventional value of the age of the universe, $\frac{1}{2}t$ is the age of the observed background[2]. Combining these results, we see that the background realizes the poet's dream of

"A rose-red city, half as old as time."[3]

E. A. MILNE.

19 Northmoor Road,
Oxford.

[1] NATURE, **137**, 904 (1936).
[2] *Mon. Not. Roy. Ast. Soc.*, **93**, 674 (1935); "Relativity, Gravitation and World-Structure" (1935), p. 108 (diagram).
[3] J. W. Burgon, "Petra", Newdigate Prize Poem, 1845.

## Glycosides of Madder

THE glycoside obtained from various species of *Galium* and *Rubia* already described in NATURE[1] has now been found to be a primveroside of purpurin carboxylic acid.

The sugar of ruberythric acid, the glycoside of alizarin, which has been known for many years, has been isolated in the pure crystalline condition from the products of enzymic hydrolysis and identified as primverose. A primveroside of rubiadin has also been obtained from the roots of *Galium Verum*.

The three glycosides are rapidly hydrolysed by enzymes present in members of the Primulaceæ. They would appear to be the first examples known of primverosides occurring in the Rubiaceæ.

R. HILL.
D. RICHTER.

Biochemical Laboratory,
Cambridge. June 2.

[1] NATURE, **134**, 628 (1934).

## Points from Foregoing Letters

NEW experiments to find whether there is a correlation between the scattering of gamma radiation and electron recoil are described by Dr. J. C. Jacobsen. In agreement with Bothe and Maier-Leibnitz, and unlike Shankland, the author finds a number of coincidences which is well beyond the experimental error. Commenting on these results, Prof. N. Bohr considers that the grounds for serious doubts concerning the validity of conservation of energy and momentum in atomic phenomena are largely removed. The root of the still unsolved difficulties of quantum electrodynamics may be looked for, he states, in the atomistic nature of electricity, which is as foreign to the classical physical theories as the quantum of action itself.

With reference to the complex molecular nature of solid sulphur trioxide, Prof. H. E. Armstrong directs attention to its value as a sulphonating agent, and recalls incidents in connexion with its early preparation by Frankland.

To account for the similarity in the graphs representing the rate of thermal decomposition and the rate of oxidation of formaldehyde and of acetaldehyde, Prof. M. W. Travers suggests that short-lived intermediates are formed in both cases.

A new vitamin, 'P', which cures pathological permeability of the walls of capillaries to plasma protein, is reported by St. Rusznyák and Prof. A. Szent-Györgyi. The new vitamin, closely allied to vitamin C, is found in Hungarian red pepper and lemon juice, and is apparently flavon or flavonol glycoside, one of the vegetable dyes.

Adenylic acid and adenosine (obtained from muscle or yeast) are found by Dr. T. W. Birch and Dr. L. W. Mapson to accentuate considerably the slowing down of the heart-beat (bradycardia) produced in rats by deficiency of vitamin $B_1$. The authors find, further, that vitamin $B_1$ helps in the elimination of adenylic acid and suggest that, when the vitamin is absent, there is an accumulation of adenylic acid and that it and similar decomposition products of nuclein are the cause of the bradycardia, not lactic acid, as sometimes stated.

The concept of a pair of equivalent particle-observers, as employed by Milne and Page, is criticised by Prof. J. L. Synge, who deduces that any two particle-observers are equivalent, and their relative velocity is zero for suitably chosen equivalent clocks.

The variations of the magnetic induction with the field applied are found by K. Mendelssohn and R. B. Pontius to follow a smooth and nearly reversible curve in the case of a sphere of tin at very low temperature (in the supra-conducting state), while in a cylindrical specimen, the graph shows step-wise changes, with considerable hysteresis. This behaviour agrees with the assumption that the time effects observed indicate a slow expansion or contraction of macroscopic supra-conducting regions.

Examples showing how the exact value of physical constants (such as density and boiling point) of pure liquids can be estimated with a high degree of accuracy from the change in boiling point of the liquids as they become purer on distillation are given by Dr. M. Wojciechowski and Dr. E. R. Smith.

A greatly increased consumption of oxygen by cartilage tissue, upon addition of methylene blue, is reported by E. G. L. Bywaters. Under ordinary conditions, cartilage splits glucose into lactic acid without the use of oxygen.

Dr. S. Dobinski finds that the haloes obtained by diffraction of electrons on a copper surface polished in air are due to cuprous oxide. Polishing in absence of air gives rise to different haloes of such size as might be expected from degeneration of the usual copper pattern.

On placing living tissue cells in pure water or in a medium free from salts, Prof. H. Grossfeld finds that the cells take a globular shape, and that a vivid Brownian movement and increase in the number of granules takes place. The author ascribes these reversible changes to the loss of diffusible electrolytes, which produces a slow coagulation of the cytoplasm.

A group of symptoms observed when rats have suffered severe injuries from various agents (cold, surgical injuries, poisoning), which seems independent of the nature of the damaging agent, is described by Prof. H. Selye, who describes it as a "general adaptation syndrome". This syndrome, which develops in several stages, includes decrease in the size of thymus, spleen, lymph glands and liver, disappearance of fat tissue, formation of acute erosions in the digestive tract, increase in adrenals, etc.

Prof. J. Kaplan finds that when oxygen is introduced into the auroral afterglow in nitrogen, the spectrum of the resulting afterglow resembles very closely the spectrum of sunlit auroras as reported by Vegard and Tønsberg. He believes that the effect is brought about by ozone as postulated by Vegard and Tønsberg.

Evidence is submitted by Dr. Howell that the ground state vibrational frequency of a molecule $AB$ is very nearly equal to the mean of the frequencies of the elementary molecules $A_2$ and $B_2$, where $A$ and $B$ belong to the same group of the Periodic Table.

A new 'dark sheath', with a sharp boundary, near the cathode of an arc discharge between the Langmuir double space-charge sheath on the cathode and the light of the 'arc plasma', is described by N. Warmoltz.

According to theoretical considerations put forward by J. Müller, electromagnetic oscillations are to be expected from a parallel-plane diode magnetron, when the magnetic field is arranged parallel to the plane of the electrodes. D. M. Tombs observes oscillations of the order of 30 cm. confirming this.

A. Hunter and Dr. R. W. B. Pearse find that in the region $\lambda\lambda$ 2500–2100 A., certain specially sensitised ultra-violet plates are actually less sensitive than ordinary plates when exposures are short or the radiation is weak. 'Sensitisation' in general increases contrast and maximum attainable density, but decreases threshold speed.

Spectra of the new star reported in last week's NATURE are briefly described by Drs. T. W. Wormell and J. C. Dobbie. The hydrogen absorptions indicate velocities which have risen from 1100 to 1900 km./sec. in two and a half days. Certain enhanced metallic lines are also present, in displaced positions, and the sharp lines of interstellar calcium are a prominent feature.

# Research Items

## Fertility and Contraception in the United States

DATA relating to the reproduction histories of 30,949 women (white and negro) overtly fertile in 1931 and 1932, and residing in or near twenty-six large cities in fifteen States east of the Mississippi and north of the southernmost tier of States, have been collected and are in course of analysis by Prof. Raymond Pearl. An important factor in any discussion of this material is the extent and effectiveness of contraception. It can alter completely the expression of variation in natural innate fertility. An attempt to evaluate the influence of this factor (*Science*, 83, May 22, 1936) shows that among the white population under investigation, 54 per cent have not practised contraception and among the negroes 83 per cent. Contrasting the two classes of contraceptors and non-contraceptors in white and negro respectively, it appears that in white and negro non-contraceptors, the pregnancy rates are identical; but among contraceptors, in the whites contraception is effective in reducing pregnancy 25–50 per cent in the various age classes, while among negroes it is without significant statistical effect in lowering the pregnancy rates below those of comparable classes of non-contraceptors. This confirms the experience of clinics that negroes do not practise contraception effectively, even after instruction. Clearly if no other variables were involved, this would result in a change in the relative proportions of the two elements in the population, which would be apparent in a very short time. There is, however, a much higher rate of production wastage (abortions, miscarriages and still-births), largely owing to the prevalence of venereal disease, among the negroes. This acts as one of several compensating factors in the birth-rate.

## Antiscorbutic Activity of a Derivative of Gluconic Acid

IT is now known that a number of compounds chemically related to *l*-ascorbic acid or vitamin C can exert some degree of antiscorbutic activity. An addition to the list is announced in a letter addressed to the Editor by Prof. B. A. Lawrow, Prof. W. M. Rodionow, E. M. Bomdas and N. S. Jarussowa, of the Vitamin Department of the Institute of Nutrition, Moscow. They have found that the methyl ester of 2-ketogluconic acid exerts antiscorbutic activity in guinea-pigs in doses of 100 mgm. or more: 50 mgm. had a curative action in about half of a group of animals suffering from scurvy, but 25 mgm. had very little effect. This ester is an intermediate product in the synthesis of *d*-arabo-ascorbic acid, which has about one-twentieth of the antiscorbutic potency of vitamin C itself (see S. S. Zilva, *Biochem. J.*, 29, 1612; 1935). It thus appears that the ester of ketogluconic acid has about 1 per cent of the activity of *l*-ascorbic acid or vitamin C. The chemical difference between the two ascorbic acids lies in the position of a hydroxyl group in the chain. The Russian authors do not discount the possibility that the gluconic ester is converted first into *d*-arabo-ascorbic acid in the animal body and that the antiscorbutic activity is due to this compound: they also state they they are extending their investigation to include an examination of the action of the ester of ketogulonic acid, which occupies a corresponding position in the synthesis of *l*-ascorbic acid. The question whether antiscorbutic activity depends upon the presence of a cyclic structure in the molecule or can also be exerted by open-chain compounds must await further investigation, but may be difficult to decide if the conditions of conversion *in vitro* can be duplicated in the body.

## Sex Change in a Fish

THE actual change of sex that takes place in a teleostean fish, *Sparus longispinis*, is the subject of a memoir by Kinoshita (*J. Sci. Hiroshima Univ.*, Ser. B, Div. 1, 4; 1936). In early life the gonad consists of a thread-like testis. Shortly after, oocytes make their appearance in tissue alongside the testis which now contains ripe spermatozoa. More of them make their appearance until a hermaphrodite condition is realized, but only functional sperms are produced. The final stage is brought about by the degeneration of the gonad of one sex, either male or female, thus leaving the old fish of the other sex. It is only when this stage is reached that functional ova are produced.

## Fungi and Graft Unions

THE partnership between stock and scion of a grafted plant is usually well adjusted. There is, however, undoubted evidence that fruit-tree stocks can influence the type of scion growth, and the scion can, under different conditions, control growth of the whole tree. Mr. T. E. T. Bond has investigated the possibility that such relations would have an effect upon the relative susceptibility of herbaceous stocks and scions to attack by disease-producing fungi (*Ann. App. Biol.*, 23, No. 1, 11–29, February 1936). Various graft combinations of potato, tomato, woody nightshade, deadly nightshade, thorn-apple, *Physalis* sp. and henbane were prepared, and were inoculated on one side of the union with either of the fungi *Phytophthora infestans* or *Cladosporium fulvum*. The resulting attacks by these fungi were the same as upon ungrafted material, thus showing no influence of the other participant in the graft union, either in preventing, or helping, fungal attack in the herbaceous plants used for the experiment.

## A Disease of the Japanese Laurel

THE common variegated Japanese laurel, *Aucuba japonica*, is but rarely the host of any fungus or bacterial parasite. Dr. G. Trapp has, however, isolated an organism, *Pseudomonas aucubicola*, a new species, which is very closely concerned in a 'die-back' disease of this popular shrub ("A Bacillus isolated from Diseased Plants of *Aucuba japonica* (Thunb.)", *Phytopath.*, 26, No. 3, 257–265, March 1936). Though the organism was consistently isolated from stem, leaf and root lesions of infected plants, very intensive attempts to re-inoculate healthy plants failed to reproduce the malady. It is considered that *P. aucubicola* is not a primary parasite, but can avail

itself of a slightly diseased condition induced by some other cause. Morphological, cultural and physiological characters of the organism are set forth at length in the paper.

### Atmospheric Vorticity

THE *Journal of the Faculty of Science*, Imperial University of Tokyo, Section 1, vol. 3, part 2, August 1935, contains a number of meteorological papers dealing with atmospheric vorticity. The first, by K. Nakata, with an introduction by Prof. S. Fujiwhara, is a study of the vertical component of vorticity. A number of synoptic weather charts are shown on which are drawn lines of isovorticity together with ordinary isobars for sea-level, for the neighbourhood of Japan for certain dates in the winters of 1922 and 1923. These show that the areas of positive (cyclonic) and negative (anticyclonic) vorticity generally nearly coincide with the cyclonic and anticyclonic areas, but that the two pairs of systems often differ in detail; that the different systems travel together; but that the distribution of vorticity is irregular in the regions lying between an anticyclone and a cyclone. The centres of maximum and minimum vorticity, in spite of the irregularities just mentioned, appeared to coincide very nearly with the main centres of low and high pressure. Later papers in the series by other Japanese writers extend the relationship to features other than the distribution of atmospheric pressure, including cloud and rainfall, and deal with the case of the typhoon. Very little is said of the difficulties that must have arisen from lack of sufficient observational material, and in the application of the classical hydro-dynamical equations to a complex and highly compressible fluid like the atmosphere; it is difficult to assess the importance for meteorology of the very laborious and difficult computations involved in this attack upon a subject which is undoubtedly of the greatest importance for progress in meteorology.

### Electrical Contacts

ALL engineers who are familiar with the working of spark coils and the phenomena which take place where the brushes press on the commutator of a dynamo realize the importance of the study of electrical arcs and discharges, but it is only recently that their effects on the resistances of the materials in contact have been considered. In *World Power* of May, G. Windred has given a useful review of recent literature on the subject. The value of the contact resistance between two metals depends largely upon the conditions at the interface between them, but it is also largely affected by the formation of oxides on the faces. It is known that copper oxides produce a marked increase on the contact resistance. For a given current this increases the heating and the cumulative rate of deposit of the oxide. At a certain critical temperature, there is a sudden fall in the contact resistance, and this is of importance in the design of heavy-current contact breakers. The main factors which influence the life of electrical contacts are their hardness and their resistance to the effects of arcing. The relays used in modern telephone practice must operate faultlessly over long periods of time and with the minimum of inspection; their effective life depending on the duty cycle which they perform and the amount of attention which they receive. The disadvantages of using copper and brass are their low melting points and their susceptibility to corrosion. This led in the early days to the use of precious metals for electrical contacts. Papers by Carter and Kingsbury published in America (*Bell Journal Reprints*, April 1928) contain practically all our knowledge of this important subject. Kingsbury deals with the important subject of contact erosion and gives experimental data obtained from eight different contact metals showing their losses in weight, volume and atomic proportions relative to platinum.

### Organic Derivatives of Silicon

IN the Bakerian Lecture to the Royal Society delivered on June 25, Prof. F. S. Kipping reviewed the work of the past thirty-five years at University College, Nottingham, on organic derivatives of silicon. With the object of determining whether silicon could give rise, like carbon, to dissymmetric molecules, a number of derivatives belonging to the two types $SiR_1R_2R_3R_4$ and $(R_1R_2R_3Si)_2O$ and each containing at least one aromatic nucleus, were prepared. These optically inactive compounds were converted to sulphonic acids, and resolutions with active bases were attempted. In each case only one active base gave the desired result. A remarkable feature was that in many cases the *d*- and *l*-acids, when combined separately with another active base, gave salts which were indistinguishable in all physical properties, including specific rotation. In the course of other investigations, it was found possible to direct attention to the great differences in behaviour between similarly constituted compounds of carbon and silicon. Thus the chlorides $SiR_3Cl$ are easily hydrolysed by cold water to silicols $SiR_3OH$, which pass readily into oxides $SiR_3.O.SiR_3$. In no case has the formation of a simple silicone, $R_2Si:O$, been observed, and indeed it seems probable that the group $>Si:O$ does not exist, nor is there any evidence of the formation of an ethylenic bond between carbon and silicon or between two silicon atoms. The diols $SiR_2(OH)_2$ and triols $SiR(OH)_3$ give rise to complex mixtures by progressive condensations, the study of which throws light on the structure of mineral silicates. Acids of the type R.SiO.OH are probably not formed. The general conclusion is that corresponding carbon and silicon compounds show very little similarity in behaviour, only a few types of carbon compounds being represented by analogous derivatives of silicon.

### Monogenic Functions

A FUNCTION of a complex variable is called monogenic at a point if at that point it possesses a unique finite derivative. It is well known that such a function satisfies the differential equations of Cauchy-Riemann; but the converse is not true. The problem of determining conditions that are sufficient for monogeneity and yet are free from unnecessary restrictions has not yet been completely solved, but an account of recent progress is given by Prof. D. Menchoff of Moscow ("Les conditions de monogénéité"; Actualités scientifiques et industrielles 329. Paris: Hermann et Cie., 1936). It is surprising to find that the demonstrations seem necessarily to involve complicated ideas of the modern theory of functions, even when the properties dealt with are apparently independent of these ideas. Perhaps some mathematician will take up the challenge, and supply the simpler proofs which, one is tempted to say, must exist.

# The Indian Institute of Science, Bangalore

IN 1926 the Government of India appointed a committee with Sir William Pope as chairman to report upon the Indian Institute of Science, and one of its recommendations was that the activities of the Institute should be subject to review by a committee every five years. Early this year, Sir James Irvine was appointed chairman of the statutory quinquennial committee, and the issue of the report of this committee is awaited with interest. It is untimely, therefore, that the March issue of our Calcutta contemporary, *Science and Culture*, should publish a severely critical article on the present administration of the Institute. Anyone cognisant of the large volume of original work which has issued from the Institute since its foundation cannot doubt that it has more than justified the hopes of its munificent founder, the late Mr. J. N. Tata. The two main heads of the recent criticisms would appear to be (*a*) that the work of the Institute is too academic and (*b*) that, since the students are drawn very largely from South India, it is no longer an all-India research institute.

Whilst it may be true that much of the work carried out in the laboratories of the Institute is concerned mainly with problems of purely scientific interest, it is difficult to see how this could be otherwise. The research work in the Institute is done by young students who go there for a training in the methods of research. If they are not to be discouraged in their early years, it is essential that they should be assigned problems likely to yield results within a reasonable time. Furthermore, we very much doubt if it is possible to undertake *ad hoc* research on industrial problems. The industrial research institutions in Great Britain work in close contact with established industries, and they study fundamental problems related to these. It is very rare indeed that a new industry results directly from an isolated piece of research. We are of opinion that the Indian Institute of Science can best assist industrial development by working in collaboration with industry, as do the universities in Great Britain with Imperial Chemical Industries, Ltd.

The contributions of the Institute to industrial development have not been negligible; we need only instance the valuable researches made in collaboration with the Forest Research Institute at Dehra Dun on the causation of sandal wood disease, the investigations on wireless transmission in the tropics, and the work leading to the establishment of the sandalwood oil and white lead industries.

All industrial advancement is dependent upon pure scientific research, and it is a matter for congratulation that Sir C. V. Raman, the present director, has already built up a school of research in physics and that he was able to attract as a visitor to Bangalore so eminent a theoretical physicist as Dr. Max Born. Whilst the rapid development of research in Indian universities, not foreseen by its founders, has doubtless made necessary a new orientation of the activities of the Institute, we cannot doubt that it will continue to play a great part in the scientific advancement of India.

# Progress in Atomic Physics

## CONFERENCE AT COPENHAGEN

PROF. NIELS BOHR held a conference on atomic physics on June 17–20 in the Institute for Theoretical Physics at Copenhagen. About eighty physicists attended the discussions, including many from foreign countries.

The outstanding communication to the conference was a paper by W. Heisenberg on the quantum-mechanical theory of cosmic ray showers. Up to the present, no explanation of the fact that particles of very high energy can produce simultaneously, or in a single process, a large number of secondary particles, has been given in terms of the quantum theory of electrodynamics. Such showers of secondary particles have been observed by Hoffmann, Blackett and other experimenters.

According to quantum electrodynamics, the effective cross-sections for the simultaneous formation of *n* pairs of electrons lead to an extremely small probability for the occurrence of large showers. This calculation was made on the assumption that only the ordinary known electrical forces are of importance in the interaction between charged particles.

The phenomenon of β-disintegration has, however, suggested the idea, as in Fermi's theory, that there exist interaction forces of a new type between electrons and heavy elementary particles such as protons and neutrons. In this new type of interaction, a fourth elementary particle, the neutrino, probably takes part, as has been suggested by Pauli. Without the neutrino, it is impossible to preserve the law of the conservation of energy in the description of β-disintegration. It follows from the existence of these new interaction forces that an electron and neutrino can be created in an atomic nucleus, the electron being emitted as a β-ray, as Fermi pointed out.

Heisenberg has given a general proof that all interaction forces of the type that produce β-disintegration lead to the production of multiple processes and particles, when initiated by particles of high energy. The process may be of the following sort. A high-speed proton strikes a nucleus and produces in the field of the nucleus a great number of β-rays in one elementary action. Heisenberg suggests that the mechanism of the cosmic ray showers is of this type.

He has succeeded in calculating the minimum energy needed by the incident particle to produce this effect, and finds that the order of magnitude is in quite good agreement with the experimental observations of cosmic ray energies.

It is hoped that this new conception of the interaction between elementary particles will suggest methods of solving the difficulties in the theory of quantum electrodynamics, which arise from the incomplete knowledge of the physical laws governing the behaviour of particles of high energy.

V. Weisskopf discussed the Dirac theory of positrons, and showed that its formulation can be simplified, and some of its paradoxes removed. P. Jordan discussed the theoretical possibility of conceiving a light quantum as a pair of neutrinos. M. Born gave an account of his theory of quantum electrodynamics. Kalckar and Bohr gave a detailed mathematical account of their theory of nuclear disintegration. O. R. Frisch and G. Placzek gave an account of the structures of energy levels in heavy nuclei, and the possibility of investigating it by means of the absorption of slow neutrons. Rosenfeld and Bohr discussed the problem of the measurement of charges, and the importance of field and charge fluctuations for the definition of theoretical concepts.

The course of the discussions was, as always, directed by the masterly fundamental criticisms of Bohr. On these occasions, when so many able theorists are gathered together, it is clear that Bohr's physical insight is the power which contributes most to the advance of theoretical atomic physics, and creates the conditions which fertilize the mathematical abilities of theoretical workers elsewhere.

The most interesting and important paper on experimental physics was, perhaps, Jacobsen's account of his repetition of the Shankland experiment (see p. 24 of this issue). Shankland failed to observe coincidences between recoil electrons and scattered quanta when observing with counters at the angles expected according to the Compton theory of the photon scattering process. He used γ-rays from radium, which cover a large range of frequencies. Jacobsen, and Bothe and Maier-Leibnitz have now repeated the experiment with the almost non-chromatic γ-rays from thorium C″. They have taken great care in defining the angles used, and have found the expected number of coincidences. These results are confirmed by some less well-defined experiments by Fermi's collaborators. Thus the suggested failure of the conservation of energy in the Compton effect, so eagerly seized upon by Dirac, in order to get rid of some of the difficulties found in the formulation of a satisfactory relativistic quantum dynamics, is not confirmed. Bohr, Pauli, Heisenberg and other theoretical workers expressed satisfaction at this result, and hoped that further discoveries would mitigate the difficulties on which Dirac comments (see p. 24).

Heitler reported that Anderson has withdrawn his claim that the energy lost by fast electrons in the cosmic rays is much less than expected on general theoretical grounds.

Miss Meitner gave an account of some work on the radioactive effects produced in uranium by the action of slow neutrons. She showed that it is very probable that elements of atomic number 93 and 94 are both formed in the process. Dr. M. L. Oliphant described some recent work carried out in Cambridge, while Goldhaber showed that the mean free path in paraffin of the neutrons produced by the photo-electric disintegration of deuterium does not have the value predicted by the accepted theoretical picture of the interactions between neutrons and protons.

Uhlenbeck described how the modification of the Fermi theory of β-decay, proposed by Uhlenbeck and Konopinski, is in good accord with experiments on the energy distribution of β-particles from both electron and positron emitters of low atomic number. Richardson gave similar evidence in the case of β-emitters of high atomic number.

The general impression left by the conference was that progress in experimental research on the atomic nucleus is very rapid, but that the advance in the theoretical description of the new results is much slower. This is due largely to inadequate theories of the interaction forces between particles of high energy separated by small distances, which are of fundamental importance in the region of the nucleus.

# Recent Advances in Wool Research

SEVERAL papers read at the Annual Conference of the Textile Institute held in London on June 3–5 dealt with wool and its characteristics.

Dr. A. B. Wildman, biologist of the Wool Industries Research Association, discussed estimations in the fleece of important wool characteristics, such as fineness variability, length, fleece density and kemp proportion. Emphasis was laid on the necessity for devising speedy and accurate methods of fleece analysis, in order that the relative merits of fleeces from breeders' flocks and from experimental sheep could be accurately measured. A historical résumé of earlier work was given, indicating that conflicting results were often due to lack of representative sampling methods. The author gave an account of his methods, which are subject to statistical control, in commencing analyses of thoroughly sampled fleeces. These investigations are intended to show the kind of variations occurring in fleeces of different types of sheep, and represent an essential prerequisite in the evolution of suitable methods for quality determination.

The quality of a fleece may be modified by exposure to light, air and water. This is attributed by Dr. J. B. Speakman, of the University of Leeds, in a paper on "The Reactivity of the Sulphur Linkage in Animal Fibres", to the oxidation of intact disulphide bonds or their hydrolysis products. More regulated changes of this nature occur in the milling, carrotting, crabbing and blowing processes. Dr. Speakman produced evidence to show that the cystine disulphide cross-linkage is more susceptible to hydrolysis in the stretched than it is in the unstretched fibre. He also showed that the contractile power of treated stretched fibres is dependent on the extent of the hydrolysis of the cystine disulphide cross-linkages, which vary with the *p*H value of the solution in which the fibre is treated.

Raw wool may contain fifty per cent of its weight of grease, suint, dirt and vegetable matter. Its cleaning is, therefore, an intricate process, and was the subject of two papers from the Wool Industries Research Association. Some of the fundamental principles of washing raw wool with solutions of soap and soda were dealt with by Dr. H. Phillips, who showed that the $p$H values of the detergent solutions used influence their wetting and emulsifying powers, and the stability of the emulsions which they form. Variations in the relative proportions of the different impurities in raw wool, caused by variations in the health of the sheep and the climatic conditions, have to be met by alterations in the washing process, which can only be foreseen when the process is under scientific control. Inherent weaknesses in the process are the effect of the alkali used on the wool and the incomplete removal of vegetable matter.

Dr. S. Townend described the frosted wool process, recently developed in the United States, by which it is claimed that large quantities of vegetable matter and grease can be removed from raw wool without subjecting it to alkaline solutions. The wool is cooled to −40° F., and the frozen grease and vegetable matter are broken up and removed by mechanical treatment. The process removes more vegetable matter than the normal washing process, but the finer qualities of wool still require carbonising after treatment. The grease content of the wool cleaned by this process is also relatively high, and for certain purposes the wool has to be washed with soap and soda.

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# Chemical Engineering Congress of the World Power Conference

H.R.H. THE DUKE OF KENT, in opening on Monday, June 22, the First International Chemical Engineering Congress at the Central Hall, Westminster, and welcoming delegates and members from thirty-seven countries, said: "Proud as each country is of the achievements of her great scientists and inventors, their work once done becomes international and contributes to the well-being and happiness of every race". The Right Hon. Viscount Leverhulme, in his presidential address which followed, dealt with the subject of chemical engineering and stated that the conception of holding an international congress of this kind was due to the late Sir Frederic Nathan, and that the development of that ideal into the present meeting was brought about by the World Power Conference.

About 120 papers from fifteen different countries were presented for discussion, whilst the membership numbered 850, comprising about 350 representatives from thirty-six overseas countries.

Two technical sessions were held before lunch and two in the afternoon on Tuesday, June 23, and Friday, June 26, but as visits to colleges, research institutions and works in and around London had been arranged for Wednesday afternoon and Thursday afternoon, the technical sessions on these days were limited to the forenoon.

Since chemical plant may have to resist corrosive conditions and may have to withstand high temperatures and/or high pressures, both the material of which it is constructed and the method of fabrication are important factors to the chemical engineer. It was therefore not surprising that the papers and discussions at the first two sessions on Tuesday morning were devoted to materials of construction. At the first of these, eight papers were presented dealing with ferrous metals and their alloys designed to resist heat, rust and acid corrosion, the forging of autoclaves and vessels for withstanding liquids at high temperatures and pressures. Nor was cast iron omitted, for included in this section were papers showing the result of recent research work on this material and its application in chemical industry, as well as others on the prevention of corrosion in underground pipe lines made of ferrous metals. The following session covered a much wider field since it contained papers on refractory materials, stoneware, plastics, rubber and such lesser known fibres as jute, coir, and sisal, as well as non-ferrous metals and their alloys, and their application in the construction of chemical plant.

Separation in the chemical industry is such a wide subject that at the third session, after lunch, the papers ranged from the theory of coal-washing through the recovery of benzol and the removal of carbon monoxide from town's gas to the production and treatment of road tars and to problems connected with the distillation of absolute alcohol, fractionation of heavy oils, modern cracking processes and graphical calculations relating to plate columns. Included in this section were other papers on filtration, recent developments in evaporation, crystallization, solvent extraction and drying.

The fourth session, which followed immediately, contained several papers relating to some interesting aspects of size reduction, among which was one describing a plant wherein low-grade fuel such as lignite can be pulverized and fired into the furnace of a boiler in one process, the boiler operating at a very high efficiency.

Another group of papers in this session considered electro-metallurgical and electro-chemical industries, as well as the electrolytic treatment of water for the prevention of corrosion and boiler scale and methods of removing small quantities of iron from soluble aluminium salts, the pasteurization of liquids, anodic oxidation of aluminium and arc welding of low carbon steels.

At the first session on Wednesday morning, the subject under discussion was destructive distillation, in which in addition to a paper on the underground gassification of coal, there was a number of papers on the problems connected with the manufacture of water gas and town's gas from lignite and similar fuels, as well as several papers on the various aspects of the development which has taken place in the gas industry in various parts of the world.

With the rapid growth of large industrial units, the disposal of waste material, whether solid, liquid or gaseous, has become a pertinent and pressing problem to the chemical engineer. It formed the subject of several papers at the next session. Coupled with this series were other papers which showed the recent developments which have taken place in the preparation and treatment of lubricating oils.

Within comparatively recent times, considerable attention has been directed towards the use of high pressures in the synthesis of organic compounds, the hydrogenation of tar and tar distillates and gaseous liquid phase reactions. The first session on Thursday morning was devoted to this subject. Included with this group of papers was one on the use of high vacua.

Few chemical engineers escape the problem of considering the transmission of heat to or the removal of heat from the product at one or more stages in the course of its manufacture. The importance of this subject therefore demanded the attention of the members during the second session on Thursday morning, when papers dealing with the evaporation of solutions liable to be affected by high temperatures, and the use of waste heat for low-temperature evaporation as well as methods by which waste heat may be recovered from intermittent sources, were under discussion.

The attendance and discussion which followed the report upon the papers on Friday morning dealing with the training of a chemical engineer indicated how this subject has been claiming the attention of both industrialists and teachers in America, Austria, Canada, France, Germany, Great Britain, Japan and the U.S.S.R.

In the session which followed were papers from Germany, Great Britain and the United States of America on administration, safety and welfare, and the statistical duties which fall to the lot of the chemical engineer in industry. These papers show how the countries concerned are taking precautionary measures to reduce accidents and occupational risks attendant upon chemical industry, and the factors which influence the choice of site for a works and the cost of the product.

Trend of development was the title allotted to the first session on Friday afternoon, at which papers were presented on a variety of subjects in which amongst others are those relating to water treatment and softening, fumigation, developments in the sulphuric acid industry and the production of concentrated fertilizers from poor phosphates. Although the papers in this group deal with many subjects, their importance to the technical worker cannot be denied, since they consider problems arising in many industries.

The organization of research stations both of a public and private character and the part which fundamental research must play in industrial organizations were the subjects of some of the papers presented at the last session, which also included other papers on rapid methods of determining the standard of the product, the standardization of chemical apparatus and its future development, as well as a number of other aspects of interest to the chemical engineer.

Sir Harold Hartley, chairman of the International Executive Council of the World Power Conference, presided on Saturday morning at the closing meeting of the Congress, at which various reports were presented. Thanks were also tendered by numerous speakers to the various committees and officers, and a striking tribute not only to the success but also to the utility of the Congress was given when it was announced that an invitation had been received from the German National Committee to hold a second International Congress on Chemical Engineering in Berlin in 1940.

# Oceanic Macroplankton of the *Dana* Expeditions*

DR. P. JESPERSEN has compared the amount of macroplankton in the various waters investigated by the Carlsberg Foundation's Oceanographical Expedition round the world in 1928–30. Volume determinations were made of 2231 pelagic hauls, distributed in eight regions—North Atlantic and Caribbean Sea, Pacific and Tasmanian Sea, Indo-Malayan region, waters west of Sumatra, Indian Ocean, South Atlantic, Straits of Gibraltar and adjacent waters, and the Mediterranean.

The paper deals solely with the purely quantitative side of the macroplankton as a whole, the only exception being a determination of the fish and fish fry of the different water layers in the regions of the Pacific: otherwise only occasional notice is taken of what organisms may be dominant—so far as volume is concerned—in the composition of the plankton. It is usually the salps which are thus noted, sometimes siphonophores, *Sagitta*, euphausiids and decapods.

A comparison of the microplankton on the two sides of the Panama Isthmus shows a very great difference. Thus in the upper water layers (50–100 metres wire) the quantity is greater in the Caribbean Sea, but in all deeper hauls the volumes are very much greater in the Gulf of Panama. It is shown that in layers corresponding to hauls with 300–600 metres wire the amount of macroplankton in the Gulf of Panama is about twice the amount in the Caribbean Sea, and in depths corresponding to hauls with 1,000–3,000 metres wire the quantities of plankton are six to eight times larger in the Gulf of Panama than in the Caribbean Sea. The remarkably rich plankton fauna in the deeper waters of the Gulf of Panama is of peculiar interest, as nowhere else in the areas of the Pacific, Indian Ocean or the South Atlantic investigated is anything like such large quantities met with. It is only in the North Atlantic at about 30° N. that corresponding quantities of plankton are found in the deeper layers.

It is characteristic of the plankton fauna of the Gulf of Panama that it is considerably richer in the deeper than in the surface layers, a condition quite unique, since at all other places in the regions investigated the quantities of plankton are greatest in the upper layers. It may be said that, on the whole, the quantity of macroplankton in the deeper layers (hauls with at least 1,000 metres wire) is comparatively small and fairly uniform in most of the tropical and temperate oceanic regions. The one exception is the Gulf of Panama, where we find a remarkably large quantity of plankton in the deeper layers.

* The Carlsberg Foundation's Oceanographical Expedition round the World, 1928–30, and previous *Dana*-Expeditions. *Dana*-Report No. 7: Quantitative Investigations on the Distribution of Macroplankton in different Oceanic Regions. By P. Jespersen. Pp. 44. (Copenhagen C. A. Reitzel's Forlag; London: Oxford University Press, 1935. 7s.

## Educational Topics and Events

BIRMINGHAM.—The degree of D.Sc. has been awarded to the following: C. T. Barber, for published papers dealing mainly with the geology of certain districts of Burma, with particular reference to natural gas and oil resources; Mabel E. Tomlinson, for papers in the *Quarterly Journal of the Geological Society* on river terraces of the lower valley of the Warwickshire Avon, and on the superficial deposits of the country north of Stratford-on-Avon, and a paper on the drifts of the Stour-Evenlode watershed (*Proc. Birmingham Nat. His. and Phil. Soc.*); G. D. Elsdon, for published work on edible oils and fats, analysis of drugs and chemicals, and numerous papers on chemical investigations in subjects relating to public health.

CAMBRIDGE.—G. C. Evans, of St. John's College, has been appointed to the Frank Smart University studentship in botany, and Dr. L. E. R. Picken of Trinity College to the Balfour studentship.

A grant of £25 has been made from the Balfour Fund to J. D. Robertson, of St. John's College, for research on the calcareous skeletons formed by marine animals.

GLASGOW.—The Bellahouston Bequest Fund Trustees have made a grant of £5,000 towards the cost of erection of the new chemistry buildings.

Prof. Gilbert Cook, professor of mechanical engineering, King's College, University of London, has been appointed regius professor of civil engineering and mechanics in succession to the late Prof. J. D. Cormack.

Prof. J. Shaw Dunn, St. Mungo-Notman professor of pathology in the University, has been elected professor of pathology in succession to Sir Robert Muir, who has retired.

Dr. H. B. Cott has been appointed lecturer in zoology.

The Gibson Lecture for 1936–37, on the history of mathematics, will be delivered by Dr. John Dougall at the Royal Technical College, Glasgow.

LEEDS.—Dr. Archibald Durward has been elected to the chair of anatomy in the University in succession to Prof. J. Kay Jamieson, who has resigned. Dr. Durward has been a member of the anatomical staff of University College, London, since 1931; he was educated in New Zealand, and held appointments for six years in the Anatomy Department of the University of Otago.

Mr. Frank Parkinson, of Messrs. Crompton Parkinson, Ltd., Manufacturing Electrical Engineers, has placed a fund of £50,000 in the hands of the Council on loan, free of interest, which is to become the absolute property of the University after seven years. The gift is to be used as a Scholarship Endowment Fund, to be applied to the foundation of research fellowships or scholarships for graduates and scholarships or grants for undergraduates. Pending receipt of interest from the fund, Mr. Parkinson has offered a sum up to £1,500 to be granted in scholarships during the first year.

LIVERPOOL.—The following appointments have recently been made: Dr. A. G. Walker, lecturer in the Department of Pure Mathematics, in succession to Dr. Haslam-Jones, who has been elected a fellow of Queen's College, Oxford; Dr. H. R. Hulme, lecturer in the Department of Applied Mathematics, in succession to Dr. G. C. McVittie, who has been elected to a readership at King's College, London; Dr. C. J. Williams, Leverhulme Foundation lecturer in the Department of Physics, in succession to Dr. Norman Feather, who has been elected to a fellowship at Trinity College, Cambridge.

LONDON.—The title of reader in neurological anatomy in the University has been conferred on Miss U. L. Fielding in respect of the post held by her at University College.

The degree of D.Sc. in botany has been conferred on Mr. D. G. Catcheside, a recognised teacher at King's College.

University postgraduate travelling studentships of the value of £275 for one year have been awarded to Dr. C. J. B. Clews (Queen Mary College), and K. Stewart (Imperial College—Royal College of Science). Dr. Clews proposes to do further research in X-rays under the direction of Prof. K. M. G. Siegbahn at the University of Uppsala, and Mr. Stewart intends to study the chemical reactions in the electric discharge under the supervision of Prof. P. Harteck at Hamburg. University postgraduate studentships of the value of £150 for one year have been awarded to W. A. Cowdrey (University College); A. J. P. Crick (King's College); J. A. Downes (Imperial College—Royal College of Science); J. Gold (University College); A. M. Houghton (King's College); Margaret M. Jamison (Bedford College); L. J. Jolley (University College); J. Lawton (University College); and the studentship awarded to Joel Hirschfield in 1935 has been renewed for a second year.

OXFORD.—At Encænia on June 24, the honorary degree of D.Sc. was conferred on Prof. E. D. Adrian, Foulerton research professor of the Royal Society.

Sir George Macdonald has been elected an honorary fellow of Balliol College.

W. E. Grimshaw, Corpus Christi College, has been granted the degree of D.Sc. for his work on plastico-viscous deformation and on combustion problems.

Dr. W. Stephenson, of the Psychology Department, University College, London, has been appointed assistant director of the newly-founded Institute of Experimental Psychology (see p. 14 of this issue).

ST. ANDREWS.—On June 26, the honorary degree of LL.D. was conferred on the following, among others: Prof. E. Waymouth Reid, emeritus professor of physiology, University College, Dundee; Prof. J. E. Littlewood, Rouse Ball professor of mathematics in the University of Cambridge; Mr. David Anderson, consulting engineer, London.

The degree of D.Sc. has been conferred upon H. Greene, for a thesis entitled "Investigations on the Soil of the Eastern Gezira, Anglo-Egyptian Sudan", and on G. J. Robertson for his investigations on Walden inversions in the sugar group.

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THE fifth Congress of the Universities of the British Empire will be held in Cambridge on July 13–17, under the presidency of the Right Hon. Stanley Baldwin. Further information can be obtained from the Secretary, Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

# Science News a Century Ago

### Patent Laws of the United States

THE act of Congress establishing the United States Patent Office under a commissioner was passed on July 4, 1836, and from that time American patents have been numbered serially. The issue of patents was provided for in the first article of the Constitution, where Congress was given power "To promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries", and the first act of Congress specifying how patents were to be issued was passed on April 10, 1790. The act of July 4, 1836, was the outcome of a Select Committee of Congress appointed "to take into consideration the State and Condition of the Patent Office and the laws relating to the issuing of Patents for New and Useful Inventions and Discoveries". In the report of this Committee, it was stated that the average number of patents issued annually from 1790 until 1800 was but 26; from 1800 until 1810 the average was 71; from 1810 until 1820 it was 200 and for the ten years previous to 1836 it had been 535. The whole number of patents issued under the laws of the United States up to March 31, 1836, was 9,731. This was more than double the number which had been issued in France or England during the same period.

### The Entomological Society

AT a meeting of the Entomological Society held on July 4, 1836, the Rev. F. W. Hope, president, being in the chair, Count Gotthelf Fischer de Waldheim, of Moscow, was elected an ordinary foreign member of the Society. The secretary made some observations upon an extensive series of specimens, represented by anglers as their artificial flies, collected by Mr. Ronalds for his work entitled "The Fly-fisher's Entomology". The president also made some observations upon the system adopted in North America whereby two crops of silk are produced in a season, as described by Mr. Kenrick in his work lately published upon that subject in the United States. (*Athenæum*.)

The Rev. Frederick William Hope (1797–1862) who was elected president of the Entomological Society in 1835 and 1846 was a graduate of Christ Church, Oxford. He presented his collection of insects and prints to the University and was the founder of the professorship of zoology.

### Lyell and Mantell

WRITING on July 6, 1836, from Kinnordy, Kirriemuir, N.B., to Mantell at Brighton, Lyell said: "Here I am rusticating in a very beautiful country, not too hot, but with weather much like a fine English spring. I am now and then devoting some stray hours to my 'Elements', like Buckland's 'Bridgewater' long promised—but not yet reviewed, thank heavens. I have received a very pleasant letter from Alexander Burnes, who has returned to Cutch and re-examined the delta of the Indus. He reports that the submerged tract which sank in 1819 is *in statu quo*. He has sent me off some Cutch secondary fossils, ammonites, belemnites, etc. His letter came in nine weeks per steamer from Cutch! A letter from Dr. Silliman informs me that my 'Principles' are being printed in Philadelphia, and nearly ready. John Murray was in hopes he had reduced the price so as to prevent this happening."

### Darwin at St. Helena

SAILING from Mauritius on May 9, 1836, H.M.S. *Beagle* called at the Cape of Good Hope and on July 8 arrived at St. Helena. "The next day," Darwin wrote in his Journal, "I obtained lodgings within a stone's throw of Napoleon's tomb: it was a capital central situation, whence I could make excursions in every direction. During the four days I stayed here, I wandered over the island from morning to night, and examined its geological history. My lodgings were situated at a height of about 2000 feet. . . . Near the coast the rough lava is bare; in the central and higher parts, feldspathic rocks by their decomposition have produced a clayey soil which, where not covered by vegetation, is stained in broad bands of many bright colours. . . . Beneath the upper and central green circle, the wild valleys are desolate and untenanted. Here, to the geologist, there are scenes of high interest, showing successive changes and complicated disturbances. According to my views, St. Helena has existed as an island from a very remote epoch; some obscure proofs, however, of the elevation of the land are still extant. I believe that the central and highest peaks form part of the rim of a great crater, the southern half of which has been entirely removed by the waves of the sea: there is, moreover, an external wall of black basaltic rocks, like the coast mountains of Mauritius, which are older than the central volcanic streams."

### Trans-Atlantic Steam Navigation

IN July 1836 the books of subscription were opened of the British and American Steam Navigation Company, the first of the pioneer companies to construct a steam vessel for regular work on the North Atlantic. The company had been formed through the exertions of the American lawyer and business man Junius Smith (1780–1853). In 1832–33 he had crossed from England to the United States and back again by sailing packets. His outward journey had taken 54 days, his return journey 32 days, and it was these passages which led to his determination to promote steam navigation across the Atlantic. At first he met with no encouragement, but finally with the aid of Macgregor Laird (1808–61), the African explorer, he was able to float a company. When sufficient money was forthcoming, a contract for the *British Queen* was made with Messrs. Curling and Young, of Limehouse, and Smith wrote to his New York correspondents: "I have the pleasure to inform you that the Directors of the 'British and American Steam Navigation Company' have contracted for the building of the largest and intended to be the most splendid steamship ever built expressly for the New York and London trade. She will measure one thousand seven hundred tons, two hundred feet keel, forty feet beam, three decks and everything in proportion. She will carry two engines of two hundred and twenty-five horse-power each, seventy-six inch cylinder, and nine feet stroke. The expense of this steam frigate is estimated at £60,000."

The *British Queen* was the first steam vessel constructed expressly for the Atlantic trade; but she did not make her first passage until July 1839, by which time the *Sirius*, *Great Western*, *Royal William* and *Liverpool* had all made passages to the United States and back.

# Societies and Academies

## Edinburgh

### Royal Society, June 1.

E. M. ANDERSON: The dynamics of the formation of cone-sheets, ring-dykes, and caldron-subsidences. Cone-sheet and ring-dyke systems are best known in Scotland and Northern Ireland, but are not confined to these districts. Cone-sheet formation may be explained by an excess of pressure, and ring-dyke formation by a defect of pressure, in an underlying magma basin, with a more or less dome-shaped roof. Solutions of the equations of equilibrium corresponding to certain shapes of basin have been found by the author.

J. B. SIMPSON: Fossil pollen in Scottish Tertiary coals. Lignites of early Tertiary age from Ardnamurchan and Mull, treated with Schulze's solution and alkali, yield a residue rich in well-preserved pollen. By this means, twenty genera of plants have been identified so far, including several not previously recorded as Scottish fossils. Of the gymnosperms *Cedrus* pollen is most abundant; *Abies* also has been noted. Dicotyledons include *Alnus, Engelhardtia, Magnolia, Planera*, five of the Asiatic genera of the Hamamelidaceæ and the Madagascan genus *Dicoryphe*. The present-day eastern Asiatic flora shows marked affinities with this ancient Scottish flora. (See also NATURE, Feb. 22, p. 321.)

H. P. DONALD: On the suppression of Tangled in *Drosophila pseudo-obscura*. An additive interaction of genes causing gaps in the venation with one causing extra tangled venation has shown that the phenotypic manifestation of a gene is no indication of its capacity to suppress the effects of another, and that genes with a recessive manifestation may have a dominant suppressing action which is not localized to the regions where the gene itself has visible effects.

H. W. TURNBULL: The revised prepared system of the quadratic complex. This deals with one aspect of the invariant theory of quadratic forms in six variables by supplementing a previous communication in 1928 to the Society.

W. LEDERMANN: On singular pencils of Zehfuss, compound and Schläflian matrices. The paper is concerned with obtaining the canonical form of pencils of matrices related to two given matrices. The types considered are the compound, power and product transformations. Quite recently Roth, Aitken and Littlewood have dealt with the non-singular cases of those. The present paper completes the work of these authors by enumerating and solving all the outstanding singular cases.

## Paris

### Academy of Sciences, May 25 (*C.R.*, 202, 1725-1824).

DIMITRI RIABOUCHINSKY: Comparative research on the aerodynamics of small and of large velocities.

JACQUES DE LAPPARENT: The formula and structural scheme of attapulgite.

DANIEL DUGUÉ: Certain modes of convergence of laws of estimation.

SERGE FINIKOFF: Some conjugated networks.

CONSTANTIN DRAMBA: The singularities of the restricted problem of three bodies.

EUGÈNE LEIMANIS: The solutions of a differential system in the neighbourhood of a singular multiplicity.

A. D. MICHAL and E. W. PAXSON: The differential in linear abstract spaces with a topology.

FLORIN VASILESCO: The generalized problem of Dirichlet and its relations with *balayage*.

RAYMOND VALTAT: A calculating machine based on the use of binary numeration.

MAURICE D'OCAGNE: Remarks on the preceding note of Raymond Valtat.

PAULINO CASTELLS VIDAL: A machine for resolving systems of linear equations.

JOSEPH CHALOM: Reaction pumps.

A. TOUSSAINT and S. PIVKO: Guided plane stream. The influence on the aerodynamical characteristics of supporting wings.

LOUIS BREGUET: The possibilities of speed and radius of action of gyroplanes. From a theoretical study it is concluded, that in addition to the advantages of vertical take-off and alighting, gyroplanes (helicopters) should, other conditions being equal, have a higher velocity and greater radius of action than ordinary aeroplanes.

MAX SERRUYS: The influence of turbulence on the polytropic coefficient of expansion in petrol motors.

STÉPHAN SERGHIESCO: The formula of Fresnel in a corpuscular theory of light.

GEORGES DURAND: The application of the mass-luminosity relation to the visual double stars.

PIERRE VERNOTTE: The theoretical dimensions of the cellular vortices of Bénard.

ROGER JULIA and JEAN FALLOU: The extension of the properties of the quadripole to the most general balanced polyphase systems.

ANDRÉ MICHEL: The conditions of demagnetization of rhombohedral ferric oxide.

ROGER SERVANT: Measurements of double refraction in the extreme ultra-violet. The measurements of P. Sève were given to 2400 A.; the author extends these to about 1860 A. and intends to extend the work in the Schumann region up to the extreme limit of transparency of the crystalline specimens.

LÉANDRE CAPATOS and NICOLAS PERAKIS: The magnetic study of the mixed crystals of divalent copper and silver. Measurements made with the complex compounds of pyridine with persulphate of copper and of silver, and of mixed crystals of the type $(Ag_xCu_y.4Py)S_2O_8$, where $x$ and $y$ vary from 0 to 1.

GEORGES AHIER: Christiansen filters. These light filters consist of a cell containing powdered glass rendered transparent by immersion in a liquid of the same refractive index. For the liquid, solutions of bromomercurate or iodomercurate of potassium and barium fulfil the required conditions better than the organic liquids usually employed.

VICTOR LOMBARD, CHARLES EICHNER and MAXIME ALBERT: The permeability of palladium to hydrogen. Loss of the diffusing power of pure palladium under the action of temperature. Regeneration of the poisoned palladium. A sheet of pure palladium, after exposure to a temperature of 500° C. or higher, suffers a marked diminution in its permeability to hydrogen. Oxidation in a current of air at 500° C. with subsequent reduction in hydrogen below 140° C. restores the permeability almost to the original figure.

MLLE. O. HUN: The determination of the total hydration of the ions of potassium iodide, by the cryoscopic method.

AUGUSTIN BOUTARIC and MLLE. PAULETTE BERTHIER: The mechanism of the ascent of hydrosols and of coloured solution through porous bodies.

MLLE. LUCIENNE CHAUMETON: The silver salts of amidosulphonic acid.

OSIAS BINDER and PIERRE SPACU: The action of malonic acid on cobaltidichloro-*trans*-diethylenediamine chloride.

ANDRÉ BOULLÉ: Calcium metaphosphates and pyrophosphates.

PAUL LACOMBE and GEORGES CHAUDRON: The mechanism of the decomposition of aluminium-magnesium solid solutions.

HENRI FOURNIER: The application of the methods of micro-chemical analysis to the study of the corrosion of light aluminium alloys. Two alloys were studied, duralumin and an aluminium alloy with 8 per cent magnesium. The amounts of aluminium determined were of the order of micrograms.

ROGER PAJEAU: The action of bromine in excess on some benzene derivatives in the presence of beryllium bromide.

LOUIS DANGEARD: Study of the oolitic limestones by staining and decalcification. Staining followed by slow decalcification brings out details of certain micro-organisms concerned in the precipitation of calcium carbonate and in the evolution of a large number of ooliths.

THÉODORE MONOD: New data on the structure of the western Sahara.

MARCEL GAUTIER: The stratigraphy of the region of Nemours (Algeria).

ARMAND RENIER: The structural plan of the subsoil of Belgium, chiefly from mining operations.

EMILE BELOT: Geophysical and mineralogical consequences of the hypothesis that the earth has had a vortex tube for origin.

HUBERT GARRIGUE: New results on the light of the night sky.

HENRI MARCELET: The presence of hydrocarbons in the product removed by deodorization in the refining of arachis oil.

PAUL RIOU, GÉRARD DELORME and HORMISDAS: The distribution of manganese and iron in the pines of Quebec.

ETIENNE FŒX and MAURICE LANSADE: The pathogenic action of a form of *Fusarium oxysporum* isolated from the potato.

DOMINGO M. GOMEZ: The decrease of arterial pressure as a function of time. Its determination in man by a piezoelectric method.

LÉOPOLD NÈGRE, ALBERT BERTHELOT and JEAN BRETEY: The action of ethyl stearate on the evolution of experimental tuberculosis of the guinea pig. In guinea pigs submitted to the action of ethyl stearate, the lesions appear later than in untreated animals.

PIERRE DRACH: The water absorbed in the process of exuviation; fundamental data for the physiological study of moulting. Definitions and quantitative determinations.

MME. VÉRA DANTCHAKOFF: Some factors determining secondary sexual characters.

MLLE. N. CHOUCROUN: Superficial electrification, a specific character of bacteria.

## Vienna

### Academy of Sciences, April 23.

GUNTHER LOCK and GÜNTHER NOTTES: Derivatives of 3,5-dimethoxybenzaldehyde (5). The Cannizzaro reaction. In the chlorination, bromination and nitration of 3,5-dimethoxybenzaldehyde, only the hydrogen atom next to the aldehyde group undergoes substitution.

OTTO DISCHENDORFER and AUGUST VERDINO: Condensation of benzoin and thymol (2). Determination of the constitution of the nitration products of 4-methyl-7-*iso*propyl-2,3-diphenylcumarone.

MAX PESTEMER and FRIEDRICH MANCHEN: Ultra-violet absorption of some aromatic hydrocarbons (4). Constitution of hexahydropyrene.

OTTO REDLICH and WALTER STRICKS: Raman spectra of *o*-dideuteriobenzene and *N*-deuteriopyrrole.

ANTON KAILAN and SIEGFRIED ROSENBLATT: Velocity of esterification of alcohols in formic and acetic acid, and of formic acid in tertiary butyl alcohol.

L. ZECHMEISTER and L. V. CHOLNOKY: Thirty years of colour science.

R. JAGITSCH and A. MASCHIN: Reactions in the solid state (2). A study of the formation of copper ferrite by the Hahn emanation method.

LUDWIG ECKHART: The line of striction of a hyperbolic ruled surface.

HUGO BONDY and VIKTOR VANICEK: Relative abundance of potassium and lithium isotopes and the emission of alkali ions from glass melts. The abundance ratios of potassium and lithium isotopes from different glass melts were found to be $^{39}K/^{41}K = 14 \cdot 1$ and $^{7}Li/^{6}Li = 12$. If a glass melt contains several alkali metals, the emission at low temperatures is due almost entirely to the element with the lowest ionization potential, and the surface of the melt undergoes impoverishment of the elements of higher ionization potential.

ERWIN FISCHER COLBRIE: Nuclear disintegration by a radium B + C source (2). Nitrogen. Protons liberated by radium C′ α-particles from nitrogen are found, by absorption measurements, to form two groups of different energy.

ADRIAN SCHUSTER: Tenebrionid (Col.) finds of Prof. Franz Werner and Dr. Otto Wettstein in the Greek Ægean Isles and in the Italian Dodecanese in 1934 and 1935.

E. STEINACH, H. KUN and O. PECZENIK: Recent researches on the action of sex hormones. (1) Castrated male rats do not show hyperæmia of the brain on injection with androsterone unless this contains œstrogenic substances. (2) The minimum dose of free male hormone required by castrated rats before copulation with a female occurs is reduced to nearly a third by the injection of female hormone. (3) The male organism is capable of converting excess male hormone into a substance with œstrogenic properties.

KARL KARAS: Kinematics of an expanding sheet.

### April 30.

F. E. SUESS: Interpretation of the occurrence of pumice stone at Köfels in Ötztale. It is suggested that this occurrence and the peculiarities of the surrounding terrain are best explained as the result of the impact of a large meteorite.

FRITZ LIEBEN and BELLA BAUMINGER: The behaviour of sugars and formic acid in the presence of oxidizing bacteria.

RICHARD SCHUMANN: The moon, sun, and variations of latitude (1).

## Forthcoming Events

### Friday, July 10

ASSOCIATION OF APPLIED BIOLOGISTS.—Summer Meeting to be held at the Royal Horticultural Society's Gardens, Wisley, Sussex.

### Saturday, July 11

BRITISH MYCOLOGICAL SOCIETY, at 11.45.—Annual Phytopathological Meeting to be held at the University of Bristol Research Station, Long Ashton, near Bristol.

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MUSEUMS ASSOCIATION, July 6–10. Forty-seventh Annual Conference to be held at Leeds.

July 7, at 10 a.m.—Sir Eric Maclagan: Presidential Address.

SOCIETY OF CHEMICAL INDUSTRY, July 6–10. Fifty-fifth Annual Meeting to be held at Liverpool.

July 7, at 10.45.—W. A. S. Calder: "The Chemist as World Citizen" (Presidential Address).

July 8, at 11.30.—Sir Robert Mond: "Works as I have seen them grow" (Messel Lecture).

DECHEMA (Deutsche Gesellschaft für Chemisches Apparatewesen), July 9–10. To be held in Munich.

GENERAL ASSEMBLY OF THE INTERNATIONAL ASTRONOMICAL UNION, July 10–17. To be held in Paris.

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## Official Publications Received

### Great Britain and Ireland

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1936 June 6. Pp. 28. (London: Royal Observatory.) [86

Joint Board of Research for Mental Disease: City and University of Birmingham. Annual Report, 1935–36. Pp. 14. (Birmingham: The University.) [106

Technical Publications of the International Tin Research and Development Council. Series A, No. 40: The Detection and Colorimetric Determination of Tin by means of Substituted 1 : 2-Dimercaptobenzenes; A Specific Reagent for Tin. By Dr. R. E. D. Clark. Pp. 6. Free. Series A, No. 41: The Preparation of Substituted Benzene-*o*-dithiols for use as Specific Reagents for Tin. By Dr. R. E. D. Clark. Pp. 7. Free. (London: International Tin Research and Development Council.) [106

The Lister Institute for Preventive Medicine. Report of the Governing Body, 1936. Pp. 28. (London: Lister Institute.) [116

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd. Twenty-first Annual Report, 1935. Pp. 96. (Cheshunt: Nursery and Market Garden Industries' Development Society, Ltd.) [116

Imperial Bureau of Plant Genetics (for Crops other than Herbage). Plant Breeding Abstracts. Supplement 2: Summary of Reports received from Stations in the British Empire, 1932–35. Pp. 63. (Cambridge: School of Agriculture.) 5*s*. [126

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1669 (Strut. 235): Behaviour in Bending of Thin-Walled Tubes and Channels. By D. Williams. Pp. 13+5 plates. 1*s*. net. No. 1670 (Strut. 256): Successive Approximation Method of Solving Continuous Beam Problem. By D. Williams. Pp. 21+6 plates. 1*s*. 3*d*. net. No. 1672 (Strut. 241): Loads and Bending Moments in Members of a Plane Braced Frame with Rigid Joints. By J. Morris. Pp. 42+4 plates. 2*s*. *net*. (*London*: *H.M. Stationery Office*.) [126

British Science Guild. The Annual Report of the Council of Management, 1935–1936. Pp. 23. (London: British Science Guild.) 1*s*. [156

London Shellac Research Bureau. Technical Paper No. 7: Fundamental Physical Properties of Lac. Part 3: Electrical Properties. By Dr. L. C. Verman. Pp. 21. Technical Paper No. 8: Darkening of Lac Solutions and the Effect of Oxalic Acid Thereon. By Dr. Lal C. Verman and Dr. R. Bhattacharya. Pp. 22. (London: London Shellac Research Bureau.) [166

City of Leeds Public Libraries: Commercial and Technical Library Bulletin. Engineering Series No. 1: Mechanics and Materials. Pp. 6. Engineering Series No. 2: Mechanical Engineering. Pp. 6. Engineering Series No. 3: Workshop Practice. Pp. 6. Engineering Series No. 4: Civil Engineering. Pp. 6. Engineering Series No. 5: Mining Engineering. Pp. 4. Engineering Series No. 6: Metallurgy and Metal Working. Pp. 6. Engineering Series No. 7: Electrical Engineering, Part 1. Pp. 6. Engineering Series No. 8: Electrical Engineering, Part 2. Pp. 4. (Leeds: Public Libraries.) [176

Department of Scientific and Industrial Research. Report of Test by the Director of Fuel Research on a Report of the Coal Research Syndicate, Ltd., at Mansfield Colliery, Mansfield, Nottinghamshire—Test carried out 28th September to 4th October 1935. Pp. iv+28. (London: H.M. Stationery Office.) 9*d*. net. [186

### Other Countries

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1935. Pp. 18. (Pretoria: Government Printer.) [26

Indian Forest Records, New Series. Vol. 2, No. 1: A Glossary of Technical Terms for use in Indian Forestry. Pp. iv+45. (Delhi: Manager of Publications.) 5 annas; 6*d*. [26

A Shellac Patent Index. By Dr. R. W. Aldis. Pp. vi+115. (Namkum: Indian Lac Research Institute.) 2.8 rupees. [26

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 138: Properties of Aluminium Sheet. By Sadao Horiguchi. Pp. 191–238. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 55 sen. [26

Department of Public Instruction: Technical Education Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1935. Pp. 8. (Sydney: Government Printer.) [26

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1935. Prepared by I. C. Mangor. Pp. 18+5 plates. (København: G. E. C. Gad.) [26

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 5, No. 4: The Motions of the O and B Type Stars and the Scale of the Galaxy. By J. S. Plaskett and J. A. Pearce. Pp. 241–328+2 plates. 60 cents. Vol. 6, No. 13: The Spectroscopic Orbit of Boss 3102. By W. E. Harper. Pp. 261–264. Vol. 6, No. 14: Periods and Light Curves of the Variable Stars in the Globular Cluster Messier 2. By Helen B. Sawyer. Pp. 265–284+1 plate. Vol. 6, No. 15: The Spectroscopic Orbits of Boss 4745. By R. M. Petrie. Pp. 285–289. 25 cents. (Ottawa: King's Printer.) [26

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 20: Correspondencia científica. Edición Oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 621. (La Plata.) [46

Commonwealth Bureau of Census and Statistics, Canberra. Official Year Book of the Commonwealth of Australia. No. 28, 1935. Prepared by E. T. McPhee. Pp. xxxi+971. (Canberra: Government Printer.) 5*s*. [46

University of Illinois: Engineering Experiment Station. Bulletin 281: An Investigation of the Durability of Molding Sands. By Prof. Carl H. Casberg and Carl E. Schubert. Pp. 52. 60 cents. Bulletin No. 282: The Cause and Prevention of Steam Turbine Blade Deposits. By Prof. Frederick G. Straub. Pp. 50. 55 cents. (Urbana, Ill.: University of Illinois.) [56

Studies in Comparative Seismology: East African Plateaus and Rift Valleys. By Bailey Willis. (Publication No. 470.) Pp. x+358+73 plates. (Washington, D.C.: Carnegie Institution of Washington.) [56

Scientific Reports of the Imperial Institute of Agricultural Research, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist and Sugarcane Expert), 1933–34. Pp. v+213. (Delhi: Manager of Publications.) 4.8 rupees; 7*s*. 6*d*. [86

Bulletin of the Department of Zoology, Panjab University. Vol. 1: Fauna of Lahore. 4: Spiders of Lahore. By Sukh Dyal. Pp. ii+119–252+plates 11–17. (Lahore: Panjab University.) 4.8 rupees. [86

Royal Observatory, Hong Kong. Meteorological Results, 1935. Prepared under the direction of C. W. Jeffries. Pp. iv+144+15. (Hong Kong: Government Printer.) 3 dollars. [106

Fiskeridirektoratets Skrifter: Serie Havundersøkelser. Hummer og Hummerkultur. Av Alf Dannevig. Pp. 60. (Bergen: A.S John Griegs Boktrykkeri.) [106

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 139: Experimentelle Untersuchungen über Licht-Schleier. Von Yenziro Awadi, Tuyosi Ogisaka, Siniti Kawasime. Pp. 241–300. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 60 sen. 126

The Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 6: Bee-keeping. By C. C. Ghosh. Third revised edition. Pp. vi+91+8 plates. (Delhi: Manager of Publications.) 1.14 rupees; 3*s*. 3*d*. [156

Index to the Records of the Geological Survey of India. Vols. 1–65 (1868–1932). By T. H. D. LaTouche. Pp. ix+718. (Calcutta: Geological Survey of India.) 6.12 rupees; 11*s*. [156

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### Catalogues

British Chemical Plant Exhibition, 22–27 June 1936, at Central Hall, Westminster, London, S.W.1: Catalogue of Exhibits. Pp. 102. (London: British Chemical Plant Manufacturers' Association.)

A Catalogue of Books: Americana, Botany, Bibliography, Classics and Classical Archæology and Early Continental Presses, also some Illuminated and other Manuscripts, including the Celebrated 15th Century MS. of three Morality Plays, known as The Macro Plays, and a Selection of Important New Books. (No. 520.) Pp. 132. (London: Bernard Quaritch, Ltd.)

Laboratory Animals for Experimental, Diagnostic and Clinical Research. Pp. 16. (New York: Breeding and Laboratory Institute.)

Nouvelles acquisitions: alchimie, astrologie, astronomie, botanique, chiromancie, hiéroglyphes, mathématique, médecine, minéralogie, occultisme, physique. (Bulletin No. 2.) Pp. 12. (Paris: Émile Offenbacher.)

Apparatus for Stereoscopic Tele-Radiography and Screen Examination. Pp. 8. (London: Newton and Wright, Ltd.)

Rare Books, Autograph Letters, Illuminated Manuscripts, etc. (Catalogue No. 600.) Pp. 74+7 plates. *Selected List* of Publishers' Remainders, being New Books offered at Greatly Reduced Prices. (Catalogue No. 601.) Pp. 26. (London: Francis Edwards, Ltd.)

A Catalogue of Books and Periodicals on all Classes of Zoology; including a Selection of Books from the Important Entomological Library of the late Robert Adkin. (*No.* 521.) *Pp.* 88. (London: Bernard Quaritch, Ltd.)

Lessing Contact Rings. Pp. 8. (London: The Hydronyl Syndicate, Ltd.)

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# Research and Finance

THE Parliamentary Science Committee has prepared a memorandum on the development and finance of the Department of Scientific and Industrial Research, including research associations. The memorandum is based upon a preliminary memorandum previously formulated by a joint committee of the British Science Guild and the Association of Scientific Workers. This joint committee may be regarded as the forerunner of the Parliamentary Science Committee, which is now, however, an independent body supported by a number of scientific institutions.

It is, of course, all to the good that a body, the membership of which embraces many distinguished scientific workers as well as industrialists, should devote its thought and energy to the question of how scientific research, and, perhaps, more especially, industrial research, in Great Britain should be developed and financed; but, equally of course, the Parliamentary Science Committee cannot claim to speak with paramount authority on this subject. Its views are its own, and the memorandum under consideration is to be regarded as its serious and constructive contribution to the general question stated above. The memorandum, when it is published in its final form, will no doubt be carefully considered, as it will deserve to be considered, by the Government and by such bodies as the Advisory Council of the Department of Scientific and Industrial Research, the Conference of Research Associations, the British Association, the Royal Society, and, it may be hoped, the Federation of British Industries—all of which having a direct interest in the subject matter of the memorandum, and each capable of contributing its own special knowledge and experience. We have been allowed to peruse the memorandum in its present form, and it may help to a constructive consideration of the very important questions raised if we endeavour to summarize briefly its argument and recommendations and to comment on them. We shall confine ourselves to the question of industrial research.

The memorandum starts by accepting as unquestionable the value of scientific research applied to the methods of industrial production, and pays ungrudging tribute to the work done by the research associations—numbering now some twenty—established under the scheme of the Department of Scientific and Industrial Research. "From six research councils only at the expense of less than £400,000 in all have come researches which have made possible a saving of £3,200,000 per annum. The aggregate saving from the work of all the Research Associations must be several times this sum and must represent a return on money invested of between 500 and 2,000 per cent."

Notwithstanding the demonstrated financial benefits that have resulted from scientific research, the problem of how to finance industrial research on a scale adequate for its maintenance and development is still acute. The real value of scientific research, whether pure or applied, is spread widely and can be financed only by finding an equally comprehensive basis for the collection of the necessary funds. Moreover, since one of the primary requirements of organised scientific research, and especially of industrial research, is that it should be prosecuted in a considered direction for a number of years, finance must provide for continuity.

The memorandum reviews briefly the methods adopted during the last eighteen years to finance the industrial research associations. At first it was

intended that, after an initial period, the research associations should be entirely dependent on the support of their respective industries. In order to set the associations going and to convince industry of the value of research, a grant of £1,000,000 was made by Government, and this fund was used to supplement the subscriptions of the industries on a £ for £ basis over this initial period, which was first sanguinely estimated at five years. This plan proved impracticable; the five years' period was extended to ten years, but, as the exhaustion of the million fund coincided with the depth of the industrial depression, it was decided that Government assistance should be continued on a different basis.

The grants in aid of the research associations now come from the sums annually voted by Parliament for the Department of Scientific and Industrial Research, and a new system—"the datum line system"—has been instituted. Under this system the Department gives grants to the research associations on a £ for £ basis in respect of all subscriptions raised above a certain fixed datum, considered necessary for the upkeep of the association on a minimum basis of efficiency. The datum varies with the industry concerned, and there is an upper limit to the Government grant, now fixed generally at three times the datum figure. Thus if the schemes were fully utilized, the relative share of the Government would be two fifths of the total income available for expenditure on research. Moreover, the principle of Government grants in aid of research is now, apparently, accepted as a permanent policy—at least as permanent as is, say, the principle of State aid for education.

The Parliamentary Science Committee's chief criticism of the existing system of finance is "the rapidly fluctuating amount of money available for research and the lack of provision for the steady development of scientific research in industry". Accordingly, the memorandum sets forth certain "proposals for finance". In effect, they are proposals for the permanent endowment of research. "The ultimate sources of money needed for research," the Committee states, "are Government and Industry," and it is suggested that *both* should contribute to provide this endowment.

Incidentally, we may point out here that, in the long run, Government money can come only from the pockets of the citizens and, therefore, ultimately, from industry. It may be convenient to speak of both Government and industry contributing, but it will be as well to keep in mind that in the real "ultimate sources" it is industry that will have to find the money. It will serve, however, to regard the contribution of industry to research as being the direct contributions of the individual firms concerned as members of the several research associations; and to regard the Government grant as being the indirect contribution of industry generally, in return for the fruits of research, of which the general consumer is in the long run the greatest beneficiary.

The Parliamentary Science Committee rejects the method of raising contributions from the several industries by a statutory levy (as is done, for example, in the case of the woollen industry) on the ground that "the effectiveness of the application of scientific research depends to a large extent on the voluntary character of the collaboration between industry and science". On the other hand, the Committee rejects the alternative system of voluntary contributions because it has "the double disadvantage of penalising those firms who contribute as against those who do not and affording an extremely irregular income for scientific research".

We think the Committee's objections to the method of raising funds for research by means of a statutory levy are sound. There may be a few industries in which it is practicable, but in many industries it would be impossible to decide which firms did and which did not fall within the ambit of the industry under levy. Moreover, it is certain that there would be widespread opposition to such a plan on the part of a very great number of industries. The need for voluntary collaboration between industry and science, if the application of scientific research to industry is to be effective, was recognized from the outset of the research associations' scheme, and was well stated in one of the early annual reports of the Department of Scientific and Industrial Research.

The argument that those firms which contribute to research associations are 'penalised' as against those who do not, seems to us entirely misconceived. Voluntarily subscribing member firms of research associations derive directly, from the research work carried out and in other ways, benefits which are not available to non-members. It is true that in the long run non-member firms must benefit, and that ultimately, as has already been pointed out, the consumer will be the major beneficiary, but at first and for a time the subscribing members of the associations must be

benefited and not penalized as against non-members. This must be a recurrent advantage with each successive discovery or advance, and is the main reason why members pay their subscriptions.

The argument that the system of voluntary contributions affords "an extremely irregular income for scientific research" has substance, but it can easily be pushed too far. Some fluctuations of income are inevitable in all organizations, whether devoted to scientific research or not, that are dependent largely for their income on voluntary contributions. It may be doubted whether the fluctuations of income in the case of the research associations, due to the voluntary character of the contributions from industry, are so "extremely irregular" as is suggested. The real trouble is not so much the magnitude of the fluctuations in the income from subscriptions, but the fact that the general average of the contributions is much too low, as the memorandum of the Parliamentary Science Committee recognizes. In any event, the fluctuations of income present a problem to the research associations not essentially different in character or, possibly, in extent, from that which individual industrial firms and whole industries have from time to time to solve. If the average income were enough, the fluctuations could well be managed, as similar irregularities are managed in business, by the building up and utilization of adequate reserve funds. These funds could well serve to 'iron out' irregularities in income. Scientific organizations in particular may be trusted to understand the functions of a fly-wheel. It seems to us that the Parliamentary Science Committee is prone to make too much of a bogey of fluctuations in income.

Having thus rejected both the statutory levy and voluntary contributions, mainly because they yield a fluctuating income, the Parliamentary Science Committee reaches, by an almost naïve logic, the conclusions that it is necessary to find some way of converting variable contributions into a fixed income and that this can be done only by the endowment of scientific research. Its proposal is "to set up a fund derived both from Government and Industry to provide a steady income sufficiently large for the basic needs of scientific research and for its expansion at a definite rate". The Committee estimates the amount required to be between £30,000,000 and £50,000,000, which might be raised immediately or by successive grants of two, three or four million pounds annually for a number of years. It is suggested, however, that the most equitable way of raising the sum would be to make it a charge on the revenue derived from the new Customs duties, such a compulsory grant to scientific research being regarded as compensation to the consumer for the loss of a free market.

"Once a Government contribution was assured, there would be no corresponding necessity for a steady contribution from industry," though the memorandum envisages contributions to the endowment fund from other sources, such as royalties from patents for the results of the work of the research associations and from statutory or quasi-statutory bodies.

Out of the annual contributions, raised as just indicated, and the interest on the sum already invested, the memorandum proceeds to say, "the current expenses for scientific research could be met according to a budget determined for some years ahead. In the end it would be hoped that science would be able to depend entirely on the interest from the fund and thus become independent of contributions from Government or Industry, although they might be required if any new developments on a large scale appeared to be necessary."

Such, stated very briefly (but not, it is hoped, so briefly as to be misleading), are the main features of the argument and proposals of the Parliamentary Science Committee for the establishment of a fund of, say, fifty million pounds, for the permanent endowment of scientific research, more especially in relation to industry.

The plan, it must be admitted, is both simple and bold. To many, indeed, it will seem grandiose. It would be impossible within the limits of a single article to examine adequately the proposals of the memorandum. But let us take one cardinal point. On what grounds is it possible to justify the removal from all Parliamentary control and criticism of the administration of essentially national funds raised by authority of Parliament? Suppose the argument to be applied to our national system of education, that, in order to secure stability and "to convert variable contributions into a fixed income", it must be permanently endowed and thus rendered independent of Government grants and, therefore, of Parliamentary control. What would be the likely response of Parliament or of the electors generally to such a proposal? To put it bluntly, are the proposals of the Parliamentary Science Committee 'practical politics'?

Again, suppose such a fifty millions fund to be raised from national resources for the permanent endowment of research. What is to prevent some future Chancellor of the Exchequer, in desperate straits to balance his budget, from raiding the research fund, as previous Chancellors have raided road funds or sinking funds? No Government can bind future Governments.

The question should be considered whether research could not better be permanently endowed by each research association building up its own reserve fund. A Chancellor of the Exchequer in a tight corner would find it more difficult to raid these several scattered 'nest eggs' than to pounce upon some big central fund. The Department of Scientific and Industrial Research should encourage the formation of such reserve funds by the research associations.

The root problem remains, of course, how to secure for the research associations increased financial support so as to give them assurance not only of life but also of an expanded and expanding life. We cannot enter into this question fully here, but one point may be stressed. It has already been pointed out that so-called "Government grants" to research associations are in the last resort the indirect contributions of industry. Government is prone to complain that industry is not making a sufficiently large direct contribution to research. Government has it in its power to increase the indirect contribution of industry by the simple device of increasing the Government grants in aid. Experience has shown that increased contributions from Government do lead to an increase in direct contributions from industry, not merely to the research associations as such but also to the individual research work of the firms concerned. Finally, we agree with the Parliamentary Science Committee that a great deal more might be done by means of organized education, publicity and propaganda to secure wider and increased financial aid for the research associations.

# Theory of Elasticity

**An Introduction to the Theory of Elasticity: for Engineers and Physicists.** By Prof. R. V. Southwell. (Oxford Engineering Science Series.) Pp. ix+510. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 30*s*. net.

A CONSIDERABLE gap exists between the preparation in engineering mechanics which is usually given in engineering schools and the preparation required to read such fundamental books as A. E. H. Love's "Mathematical Theory of Elasticity" or Lord Rayleigh's "Theory of Sound". Owing to this gap, new developments in the theoretical sciences are very slow to find their way into engineering literature, and it sometimes happens that very powerful methods which could be utilized in solving engineering problems remain for many years without applications. A striking example of this situation is represented by Clerk Maxwell's important paper "On the Calculation of the Equilibrium and Stiffness of Frames" (*Phil. Mag.*, **27**; 1864). In this very condensed paper a general method of analysis of statically indeterminate trusses was developed for the first time. Although the problem of handling statically indetermined structures is of great practical importance, Maxwell's solution of the problem remained unknown to engineers until ten years later, when the method was rediscovered by O. Mohr (*Z. Architekten- und Ingenieur-Vereins zu Hannover*, p. 223; 1874), and put in the form which is now largely used in our theory of structures. Another example is represented by Rayleigh's method of approximate solution of vibration problems, which is so extensively and skilfully used by Prof. R. V. Southwell in the book under notice. Although the method was developed more than fifty years ago, its incorporation into English engineering books is a recent development.

Modern development of engineering is in the direction of more and more intensive utilization of pure science in solving practical problems. A designer interested in problems of strength of machine parts or engineering structures can no longer be satisfied with semi-empirical formulæ of strength of materials, and very often must go into a more refined analysis of stress distribution which can be done only by using the theory of elasticity. Under these conditions, engineers at the present time are becoming more and more interested in advanced study, and the purpose of Prof. Southwell's book is to provide the necessary preparation in the theory of elasticity required for reading more advanced books in that field.

The first three chapters of the book deal with problems which are usually discussed in books on

the theory of structures. The author, by using Hooke's law and the principle of superposition, develops such fundamental theorems as the reciprocity theorem and Castigliano's theorems. The importance of these theorems is illustrated by many interesting examples. There is given also a general proof of the principle of superposition which is based on the use of Hooke's law. However, since there are exceptional cases in which Hooke's law holds while the principle of superposition cannot be applied, it would seem more satisfactory simply to postulate the principle of superposition and limit the discussion to those problems where it holds. The third chapter of the book deals with 'self-strained' bodies and structures. These important problems are usually treated with great brevity in books on strength of materials, and engineers should be thankful to Prof. Southwell for his very complete presentation of this subject. Beginning with very simple problems, he finally develops the general theory for handling self-stressed systems and gives an original and very instructive proof of Castigliano's theorem of least work, which enables him to introduce an interesting discussion of Saint Venant's principle.

The following four chapters contain material usually treated in books on strength of materials. An elementary theory of stress and strain is given and also the application of this theory to problems of torsion and flexure. It seems that in this place also the Mohr circle might have been discussed advantageously, instead of postponing its presentation to a more advanced chapter on the general analysis of stresses. In discussing deflections of beams, Macaulay's method is given. On the Continent, it is usually called Saint Venant's method, since Saint Venant originated the special method of integration which reduces the deflection problem under various conditions of lateral loading to the determination of only two constants of integration. The last of these four chapters deals with more complicated problems of stress analysis, including a treatment of helical springs, beams on elastic foundations, crankshafts and an elementary theory of bending of plates. A very complete discussion of boundary conditions in the theory of plates is added to this chapter.

The next five chapters deal with the fundamentals of the theory of elasticity. The discussion begins with a general analysis of stress and strain which at once requires a more elaborate system of notations than was used in the earlier portion of the book. Beginners in theory of elasticity usually have difficulty with symbols, and would appreciate the use of a system of notation which can be applied both in elementary strength of materials and in the theory of elasticity. In a book attempting to bridge the gap between elementary strength of materials and the theory of elasticity, this unification of symbols seems doubly desirable. However, Prof. Southwell prefers to change his symbols at the beginning of the chapters on elasticity, and he adopts in these chapters the notations of Kirchhoff and Love. From the point of view of engineers and designers, it seems very desirable to have some unification of symbols used in the theory of elasticity, and perhaps it is time to do some work in this direction. However, Prof. Southwell is sceptical regarding the possibility of any international agreement in regard to symbols after so much has been written in this field.

In Chapters xi and xii, the general equations of the theory of elasticity are applied to such important problems as torsion and bending of prismatical bars (Saint Venant's problem), to two-dimensional problems, and to cases of axially symmetrical stress systems. The author gives not only the theoretical solutions of the problems, but discusses also various experimental methods of solution such as the soap film and photo-elastic methods, which in recent times have been developing so rapidly in connexion with technical applications of the theory of elasticity.

The last two chapters of the book deal with stability and vibration problems. Here it is shown how these problems can be advantageously handled by using Rayleigh's approximate method. At the end, Prof. Southwell raises the controversial question of priority connected with the Rayleigh-Ritz method. Without doubt, the fundamental idea of this method belongs to Rayleigh, but the part of Ritz should not be minimized, since he added much in its development. Rayleigh used the method only for an approximate calculation of frequency of the gravest mode of vibration of complicated systems, and was doubtful (see Rayleigh's papers in *Phil. Mag.*, **47**, 566; 1899: 22, 225; 1911) regarding its application to the investigation of higher modes of vibration. Ritz generalized the method and made of it a powerful tool for solving problems of engineering and mathematical physics.

It is the belief of the reviewer that in this book, Prof. Southwell has made a very valuable contribution to the literature of the engineering sciences. It can be recommended both to students who wish to pursue advanced studies in the field of elasticity and also to engineers interested in application of the theory of elasticity to problems of machine and structural design. Throughout the book one finds a clear presentation of the subject given by a man who himself has contributed to its development. The book contains many interesting problems which give the student an opportunity to try his own skill and thus to improve his knowledge by exercise.

S. TIMOSHENKO.

# Insulin

**Insulin:**
its Production, Purification and Physiological Action. By Douglas W. Hill and Dr. Frederick O. Howitt. Pp. xi+219+4 plates. (London: Hutchinson's Scientific and Technical Publications, 1936.) 12*s*. 6*d*. net.

IN the fascinating history of the gradual unfolding—it is too early yet to say elucidation—of the function carried out by the pancreas by means of its internal secretion, insulin, one is above all impressed by the ingenuity of the physiological experiments, which, in the early days, at all events, rather overshadowed the chemical work.

When the authors of this monograph set themselves the task of sifting the evidence that has accumulated since the first preparation of insulin, it was indeed a difficult one. "Very little systematic work under well-defined and what may be called standard conditions has been recorded. Hence it is difficult to place a fair estimate on the value of the results from each set of experiments". They make this observation concerning the action of insulin, but, with some notable exceptions, the criticism is true of much of the work on this hormone. Among the exceptions, the authors might have given greater prominence to the outstanding work of Abel, Freudenberg, Scott and their collaborators.

The book attains a highly valuable object in that it is provocative of further research. Whether it be some important question of principle or theory, or some smaller point of observation of fact, it is certain that it must stimulate the seeker after truth to find the answer to many problems left unsolved. Time and again the authors show how contradictory are the results that have been published: one set of workers forming one conclusion, whilst the evidence of another group leads to the reverse. The reason for the diversities of opinion is nearly always to be found in one or both of two causes: either too little allowance has been made for animal variations (for example, one rabbit serving as control for another), or, effects ascribed to insulin have, in reality, been obtained with samples of such impurity that they would be more correctly described as protein mixtures containing some insulin. It is frequent in the literature to find no reference made either to the method of test or to the potency of the sample used, which makes it quite impossible to assess the value of conclusions.

Before the chapters on the chemical, physical and physiological properties of insulin, the authors wisely direct attention to the relative impurity of much of the material used, which, as they suggest, may yet furnish records of some value. It is difficult to see, however, how any value could be attached to observations on the solubility of 'insulin' of potency 40 units/gm., that is, containing 99·8 per cent of impurity. Even in 1923, when these observations were published, much purer material was available.

Of particular interest is the chapter that deals with the effect of the other hormones upon insulin action, and it is a tribute to the authors that one should be led to speculate beyond the subject that they set themselves to treat, stimulated to inquire further into the question of endocrine balance.

The section on standardisation calls for some criticism. The emphasis laid on such questions as the distribution of sugar between plasma and corpuscles, which has little bearing on standardisation, in which whole blood is always laked, is an extravagant use of valuable space when some interesting aspects of testing could not even be touched on. In a work of which the stated object is to sift the evidence, it is surprising to find quoted an observation made in 1923 to the effect that at least three rabbits should be used for a test, whilst no mention is made that for years now about five tests on twenty rabbits each would be considered a reasonable number for an accurate assay. The suggestion of the greater regularity of behaviour of mice is not in accord with the general consensus of opinion to-day. The observation of Marks, that the mouse test gives results 15–30 per cent higher than the rabbit test, was made with crystalline or highly active amorphous insulin using a standard of much lower activity: it has been shown that the discrepancy may be in the opposite direction when relatively inactive substances are assayed.

The book is attractively presented, and the subject matter most clearly arranged. Above all, the bibliographies at the end of every chapter will be of inestimable value.

K. C. L.

# A Book of Fishes

**Naturgeschichte und wirtschaftliche Bedeutung der Seefische Nordeuropas**

Von Prof. Dr. Ernst Ehrenbaum. (Sonderausgabe aus dem Handbuch der Seefischerei Nordeuropas, Band 2.) Pp. x + 337 + 26 plates. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1936.) 44 gold marks.

DR. ERNST EHRENBAUM, formerly of Heligoland, afterwards director of the Fisheries Institute in Hamburg, has been for many years one of the best known and most trusted of all the many naturalists engaged in fishery investigation. Dr. H. Lübbert, once better known as Captain Lübbert, is a rare blend of seaman and scientific man; he has had more to do than any other man with the development of the German sea-fisheries, and he has been called in to advise Governments in many parts of the world. Thirty years ago, Captain Lübbert founded *Die Fischerbote*, one of the very best of all fishery journals; and for most of the time since then the two have edited it together. Now they have embarked on the great enterprise of publishing a "Handbuch der Seefischerei", of which a good many parts are now ready, and which will form at last an encyclopædia of all our northern fisheries—from the Murman Coast to Brittany, from oysters to whales. Nearly two hundred years ago Duhamel du Monceau did much the same thing, and did it wonderfully well; another hundred years and we come to Isaac Walton and Cotton's "Universal Angler"—little, but good; yet another fifteen hundred years and we make the best we can of Oppian.

The first volume of the great "Handbook" contains, or will contain, a sketch of oceanography, a description of the sea-bottom, an account of marine vegetation, a discussion of the diet and ultimate sources of nutrition of marine animals, and in general of the balance of Nature in the sea. The book before us is the second volume, and deals systematically with the fish of our northern seas; it gives a full but very concise account, in some 300 closely printed and richly illustrated pages, of all our marine fishes; and not only the salmon but also most of our fresh-water fishes come into the story also, as inhabitants of the Baltic Sea. Almost every fish has its figure, except a very few which are obviously not needed here: such as some of the rarer deep-sea *Macruri*, or some of the Mediterranean and Atlantic fishes, *Box*, *Sparus*, *Pagellus* and the like, which only come to our northern seas as errant stragglers. Few of the figures are original; they are mostly drawn, and admirably reproduced, from Smitt, Collett, Joubin, Day, and occasionally Cuvier.

This is a book not only about fish but also about fisheries; for ours is a commercial age, and we want to know the fish in the market as well as the fish in the sea. Day's "British Fishes", written fifty years ago, and for most purposes our standby still, is an excellent book, full of information and knowledge. But the fisheries of the world have changed mightily in the half-century from Day to Ehrenbaum. When Day wrote, the saithe (for example) was caught "by angling, or line-fishing, the lugworm being found a good bait"; it was "not much sought after, being held in little esteem". But now, as Ehrenbaum tells us, 100,000 tons (114 million kilos) were brought to market in 1932 from our northern seas, all the way from the North Sea to Iceland and Spitsbergen. Fifty years ago, the megrim was a rare fish, to be recorded one by one; to-day at least 6,000 tons come to market every year, and it fetches a good price, in Germany even a high one.

The catch and the value of each and all of the marketable fishes are dealt with briefly but adequately in this book, but so indeed is every other part of the subject; Dr. Ehrenbaum omits little, and forgets nothing. The few pages on the cod tell how G. O. Sars studied its development, how Michael Graham and others have studied its rate of growth, what Hjort has written on its migrations, how Einar Lea has studied its scales. An excellent account of the mackerel tells of its migrations between the deep sea and the coastal waters, how its diet changes with place and season, and how it fasts about Christmas or New Year; how we catch it, on one hand by line and on the other by the trawl; and how, unlike the salmon or the sprat, it seems to spawn at one and the same time, whether off the Irish coast or at Heligoland. The part on the tunnies, tunny, bonito, germon, pelamyd, albacore and so on, in all their puzzling and shifting nomenclature, is particularly good. There is an up-to-date account, based mostly on R. S. Clark's work, of the many northern skates or rays and their eggs; Holt's work on the gobies, Tate

Regan's amazing account of the males of *Ceratias*, the work of C. J. G. Petersen and many others on the varying rate of growth of plaice according to the density of population and the available food, and of course Johannes Schmidt's epoch-making studies of the eel—all these are among the many matters clearly and lucidly explained.

In short, this is a good book and a useful one all through. It is not for easy reading but for reference and study; and few will open it without finding what they want to know. D. W. T.

# The New Agriculture and World Peace

**Nations can live at Home**
By Dr. O. W. Willcox. Pp. 279. (London: George Allen and Unwin, Ltd., 1935.) 10*s*. net.

PEACE is the paramount need of the world to-day. Of the many factors, complex, obscure and profound, which tend to endanger peace and produce war, one at least can be definitely diagnosed as the increasing pressure of population, in some parts of the world, on land resources. Any practical means that can be applied to reduce that pressure should, if coupled with the requisite social and political adjustments, become a powerful agent of world peace. Such is the message of this book, a message of profound and vital importance, of particular interest to scientific agriculturists and students of population problems, but also of wide general appeal. Many nations are at present quite unable to obtain from their own soil all their requirements in food and raw material, which they must import accordingly and pay for by exports. But with the vast shrinkage in international trade and the increasing difficulties of keen and world-wide competition, this method of obtaining the desired supplies may appear, to some of the nations so situated, as much more difficult and less satisfactory than that of actual, and if need be aggressively, warlike attempts to find additional territory outside their own boundaries. Dr. Willcox, however, now offers to the peoples in these straitened and parlous circumstances a simpler, easier and much more effective method: that of greatly increasing the yields of their own soil, by using to their fullest extent the wonderful powers of crop productiveness that modern plant-breeding and soil science —the new agriculture or agrobiology—has placed within their reach.

The book makes a powerful and compelling twofold appeal: first, because of the inherent interest of the wonderful results claimed on behalf of agrobiology in respect to vastly increased yields from the land; and secondly, the profound economic, social and political consequences of such agrobiological advance.

Whilst fully admitting, however, that plant-breeding or genetics and soil science have made immense strides and produced results of the kind and magnitude herein described, backed up indeed by large-scale field work in many parts of the world, it nevertheless seems to the present reviewer that the difficulties due to such things as plant pests, drought, flood and other meteorological disturbance, the human element, and above all costs, have just possibly been brushed aside a little too indifferently.

It was perhaps scarcely possible, within a book of this compass, to deal fully with all the practical difficulties in technique. The far greater difficulty is that of getting the new methods generally adopted by those very conservative and sceptical people, the farmers. In the very interesting chapter dealing with the special conditions in various 'deficit' or 'beyond the threshold' countries —Great Britain, Germany, Italy, Japan—Dr. Willcox describes the remarkable results obtained by the Better Farming Association in Japan, in the matter of rice yields. The best type of farmer, using the best and most productive variety of rice plant, under the best agrobiologic conditions, obtained yields several hundred per cent above the average. But it was very difficult, if not impossible, to arouse the interest of the majority of farmers in Japan.

There is, of course, the further complication of over-production in those parts of the world which are mainly agricultural, and supply world markets. This is touched upon in the present book, and provided for plausibly if not too convincingly.

Some of the figures given for crop yields or possibilities are startling enough, especially when combined with reduced crop cycles so that several crops can be taken from the unit of land each year. These are studied at some length in relation to population density, and the relative values of different crops from the protein-carbohydrate ratio point of view. It is generally concluded that population densities up to 15,000 or more per square mile are not beyond the bounds of agrobiological possibility; but it is scarcely fair to the author to state these bald figures without the accompanying well-reasoned arguments in support.

W. G. L. C.

**Libraries for Scientific Research in Europe and America**
By H. Philip Spratt. Pp. 227. (London: Grafton and Co., 1936.) 10s. 6d. net.

THIS informative little book is the result of a series of tours made by the author in Europe and North America, and sets out to describe the research facilities existing in the more important specialist libraries of the two continents—not only from the point of view of the librarian who wants to know the latest methods in actual use, but also from that of the research worker anxious to learn in what way modern libraries administer to his needs in the search for published information on his subject.

After describing six representative libraries in London, the author takes us *via* Paris and Brussels to Scandinavia, Germany, Poland, and Russia—finding in the latter country that most of the libraries are dominated by "books on science (and communism)"—and thence to America, to which about one half of the book is devoted. In the case of each library—and nearly a hundred are included in the book—Mr. Spratt gives details of the arrangement of catalogues and indexes, of the classification used (with a distinct leaning towards the Universal Decimal Classification), of information services and the provision of photographic and other apparatus, and of the general administration in so far as this interests the public as users.

The survey is thorough and there is evidence throughout of the author's practical knowledge of the problems involved and of his first-hand inquiry into the present methods of dealing with them. The index is well constructed but lacks balance. The entry "British Museum, 47" supplies the information that the Bibliothèque Nationale ranks with the British Museum, while "John Crerar Library, 186" refers the reader to a five-page description of that institution.

A. G.

**Primitive Law**
By A. S. Diamond. Pp. x+451. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 25s. net.

MR. DIAMOND holds that Sir Henry Maine's conception of primitive law as inseparable from the concepts of primitive religion and morality is no longer tenable in the light of modern research, and, further, that in the development of early law there is a parallelism which corresponds with economic and social progress. Thus the code of Hammurabi, for example, is formulated in a society which corresponds in economic development with the societies which produced the codes of medieval Europe. The undoubted religious elements which appear in the codes as they have come down to us are due, he holds, not to the fact that they embody survivals from an earlier stage in which religious belief, law and morality were undifferentiated, but are due to introductions by priestly scribes at a date later than the formulation of the codes.

Mr. Diamond has made a careful analysis of such early codes as have survived, and has surveyed in detail the practice of modern primitive peoples for evidence in support of his view. This vast mass of fact brings out clearly certain weaknesses in the over-simplification inherent in Maine's point of view and method. On the other hand, as regards Mr. Diamond's principal contention, however much may be conceded to priestly intervention, the distinction by which the author would seek to rule out Maine's view is largely a question of definition and determination of the point at which what he regards as law begins.

**The Extra Pharmacopœia of Martindale and Westcott**
(Published by direction of the Council of the Pharmaceutical Society of Great Britain.) Twentieth edition. Vol. 2. Pp. xxxvi+889. (London: The Pharmaceutical Press; H. K. Lewis and Co., Ltd., 1935.) 22s. 6d. net.

W. H. MARTINDALE, who had for many years carried on his father's work as author of the "Extra Pharmacopœia", died in 1933. He had brought out a new edition every four years and the book has become indispensable. He produced the first volume of the twentieth edition in 1932. The second volume has now been prepared by a committee of the Pharmaceutical Society—under the editorship of Mr. C. E. Corfield, the editor of the "British Pharmaceutical Codex". This committee has undertaken the heavy task of preparing future editions. It has always been a source of wonder that Dr. Martindale should be able to do all this by himself; Dr. Westcott's collaboration only lasted for a period.

The first volume deals with the manufacture, composition and uses of drugs. The second volume consists of a series of appendixes dealing with diverse subjects such as the analysis of bread and butter, health resorts, disinfectants and proprietary medicines. The committee has managed to carry out a thorough revision without destroying the book's individuality. Most of the familiar sections are still there, expanded slightly and brought up to date. The section on modern views of atomic structure now occupies six pages. Modern methods of biological assay have been included, and there is much interesting information about recent work on hormones and vitamins.

**Mechanics and Hydrostatics**
By Dr. R. G. Mitton. (Dent's Modern Science Series.) Pp. ix+275. (London: J. M. Dent and Sons, Ltd., 1936.) 3s.

THIS volume has been designed to cover the School Certificate and Matriculation courses in mechanics and hydrostatics. The author has presented the subject matter in a very lucid and interesting manner, and a noteworthy feature is the number of excellent photographic reproductions illustrating the practical applications in industry of the principles discussed. It will also be encouraging to up-to-date teachers to find that the author has adopted the policy of treating absolute units as fundamental from the earliest stages.

The book is amply supplied with exercises, many of which have been taken from the various School Certificate and Matriculation examination papers. Answers to these are also given.

# Seasonal Changes in the Underwaters of Bermuda

By Prof. Walter Garstang

AFTER a visit last year to the Bermuda Biological Station, I directed attention in a semi-popular article to the unique opportunities at this lonely Atlantic island for oceanographic research, and suggested that continuous local investigation of the deep water around the island would be likely to hasten a solution of the "Atlantic Water" problem, which has such important bearings

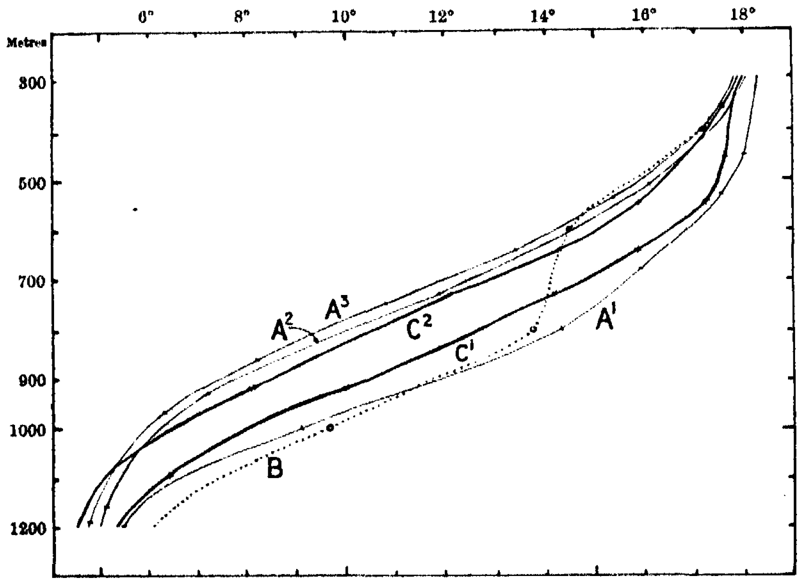


FIG. 1. Temperature curves of selected Bermuda stations (intermediate layer only).
$A^1$, $A^2$, $A^3$: *Atlantis*, February, April and December 1932, respectively.
$B$: *Bache*, February 1914.
$C^1$, $C^2$: *Challenger*, April and May 1873, respectively.

on European fishery and other questions (*Discovery*, December 1935). This opinion has been considerably strengthened by the subsequent study of various hydrographic reports, and especially by a collation of the published data recorded by various research vessels in the immediate neighbourhood of the island.

Temperature and salinity determinations at the following stations have been used: H.M.S. *Challenger* (temperatures only), stations 37 (April 24, 1873) and 57 (May 30, 1873); st. 10179 of the U.S. Fish Commission's vessel *Bache* (Feb. 18, 1914); st. 1339 of the Danish *Dana* Expedition (May 10, 1922); and six stations of the Woods Hole Oceanographic Institution's vessel *Atlantis*, namely, 1125 (Dec. 5, 1931), 1145 (Feb. 17, 1932), 1220 (April 17, 1932), 1359 (Aug. 27, 1932), 1431 (Dec. 5, 1932), and 1464 (Feb. 12, 1933). These stations are dotted about the island in various directions, all within a radius of sixty miles, except the first *Atlantis* station (1125), which lay 120 miles to the north-west. The data for this station furnish one of the extremes in the range of variation, but its inclusion seems to be amply warranted by a comparison with other stations at the same period.

The general characteristics of the water-column in the Sargasso Sea are well-known, and many temperature curves from the region have been figured by the *Challenger*, *Dana* and other expeditions. All show beneath the variable surface region two more or less vertical portions, representing relatively uniform layers: (*a*) a sub-surface layer of high salinity (*c*. 36·5 per mille) below the influence of solar radiation (150–400 metres), but preserving the effects of winter convection at a nearly constant temperature of 17°–18° (the average surface minimum), and (*b*) the deep waters (below 1,000 metres) of low salinity (less than 35·0 per mille) and temperature less than 5°. Between these two strata lies an intermediate layer (*c*. 400–1,000 metres) the variations in which are the main subject of this communication. It ranges over a considerable series of closely stratified temperatures and salinities, which confer a characteristic slope upon this portion of the curve. When the curves of the various Bermuda stations are superimposed upon the same large sheet of graph paper, it can be seen that the slope representing the intermediate layer changes its position with the season of the year, running at a higher level and to the left (that is, nearer the surface and through lower temperatures) during the summer and autumn, and lower down to the right (that is, through higher temperatures) during the winter and early spring—the very opposite of seasonal changes at the surface. Temperature and salinity curves follow the same orderly cycle, which, so far as the records go, differs only in amplitude from one year to another

(Fig. 1). The *Bache* curve for February is unique in showing autumn conditions above and winter conditions below. The soundings must have been taken while the winter change was in progress.

In the available space only a few of the curves can be conveniently reproduced, but the regularity of the sequence and the varying amplitude of the annual change come out almost equally well if we take a few representative isotherms and isohalines from the curves, and plot their levels in the water-column at the various times of the year represented. The invaluable *Atlantis* data naturally furnish the basis of such a diagram (Fig. 2). The continuous lines represent the varying depth of the isotherms 17°, 15°, 11·5°, 8° and 6° and between the first four of these the isohalines 36·2, 35·6 and 35·2 per mille run as lines of dots and dashes. The *Challenger* records in 1873 for April ($C^1$) and May ($C^2$) have been connected with those of the first *Atlantis* February, the *Dana's* for May 1922 with the *Atlantis* April, and the *Bache's* for February 1914 with the second *Atlantis* December—of course, merely for convenience of reading.

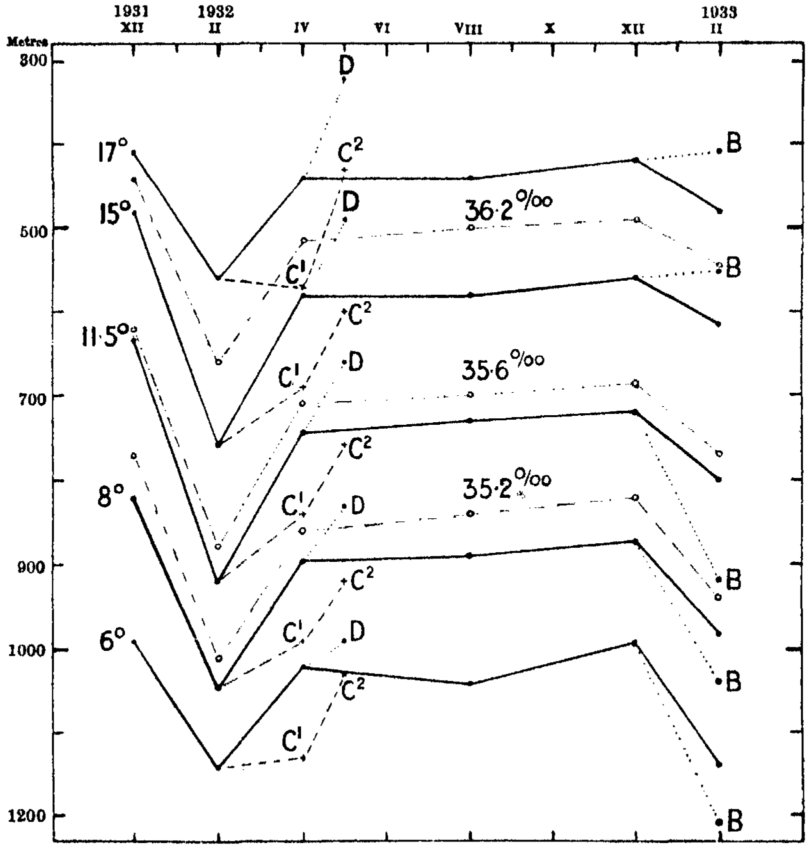


FIG. 2. Depth of selected isotherms and isohalines from the complete curves, showing monthly changes.
●—, *Atlantis* isotherms.
○—·—, *Atlantis* isohalines.
×— —, *Challenger* isotherms ($C^1$, April; $C^2$, May 1873).
● . . . , *Dana* (*D*) and *Bache* (*B*) isotherms.

It is plain from the figure that the active parts of the annual cycle are concentrated in the period from December to April or May. In February there is a sharp drop in the level of the isotherms (and isohalines) by some 100–300 metres, and in April (or April and May) a corresponding, but not necessarily an equivalent, rise. It should be borne in mind that, owing to the normal graduation of temperature and salinity from above downwards, the lowering of an isotherm implies a deepening of the mass of warmer water above it, and the lowering of a whole series of isotherms a general increase of temperature throughout the water-column represented. Similarly, a raising of the isotherms implies an upward extension of the colder waters and a corresponding decrease of temperature at the depths under consideration; so also with isohalines and salinity, *mutatis mutandis*. From April to December, the *Atlantis* isotherms and isohalines show little or no changes of level, though there is a slight upward tendency, especially of the isohalines. It may therefore be inferred that the relatively low levels of the *Challenger* isotherms in May 1873 and the high levels of the *Dana* isotherms in May 1922 were probably maintained throughout the summer of their respective years, implying relatively high temperatures throughout the intermediate layer in the summer of 1873, and low temperatures in 1922. The conditions in 1932 were intermediate, but nearer those of 1873 than of 1922, though attained earlier, in April instead of May. Confirmation of the exceptional warmth of the intermediate waters throughout the Sargasso Sea in the summer of 1873 has in fact already been given by Helland Hansen when comparing the *Challenger* station 65 (halfway between Bermuda and the Azores) with corresponding stations of the *Michael Sars* in June 1910 (Murray and Hjort, 1912, Fig. 210).

So far, I have described this sequence in terms of obvious changes in the level of isotherms and isohalines, which, as oceanographers know, are

liable to disturbance from a variety of causes. Although some of these factors could at once be eliminated from the present case, it is sufficient here to note that the Bermuda cycle is not conditioned simply by a periodic undulation of the isotherms, but by measurable changes in the temperature-salinity ratio. Fig. 3 shows the salient differences in the salinity associated with various degrees of temperature at the Bermuda stations regardless of depth. The ratio of salinity to temperature attained a maximum height in December 1931, and was followed in February by

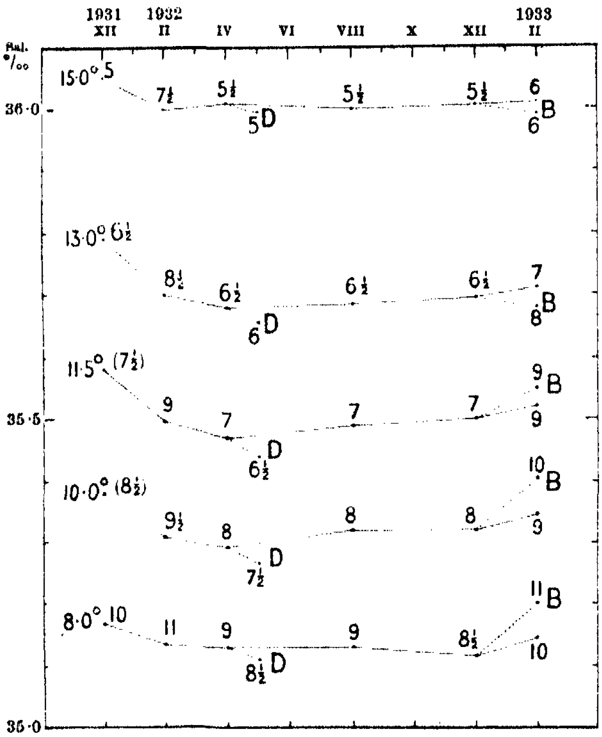


FIG. 3. Salinity ratios for selected degrees of temperature (from *T/S* curves). The numerals represent approximate depths in hektometres. *Atlantis* data with addition of *Dana* (May) and *Bache* (February).

a smart fall, which continued to April. The *Dana's* records for May 1922 show the minimum for the whole series, thus pointing to the probability that a fall in the salinity ratio is a regular phenomenon from February until April or May. After April 1932, the ratio rose slightly through the summer and autumn to December, when it was succeeded by a marked rise in the following February, greater for the lower degrees of temperature than the higher.

The apparent inference to be drawn from these changes is that occasionally in February (1932), and regularly in April or May, there takes place a general infiltration of alien water of less than normal salinity, the influx of which declines during the summer and autumn and is usually cut off more or less completely in February (1914, 1933). This cycle is, of course, precisely that of ice-bound coastal waters, locked up by frost in winter, and released in full flood in spring. The only possible source of such water in the present case is the coastal tract of mixed waters on the north side of the Gulf Stream, mainly derived, according to Bigelow, from the Gulf of St. Lawrence by the Cabot Strait, but mixed undoubtedly with Gulf Stream overflows and the coastal waters of the Gulf of Maine, probably also in severely 'Arctic' years like 1929 with contributions from the Labrador Current itself.

This conclusion may seem to conflict with some recent opinions as to the nature and relations of the Gulf Stream, but, so far as I can see, it is not opposed by any established facts. If we turn to Jacobsen's hydrodynamic current-charts (1929, figs. 53–56) we find the hub of the Atlantic circulation placed off Cape Hatteras in lat. 36° N., long. 74° W., where Gulf Stream and Antillean Current turn markedly east and give rise to great eddies on the right, some of which are completed as inner, middle and outer anticyclonic circuits, the middle one bathing Bermuda on its way to the Windward Isles to a depth of some 500 metres. As the depth of reference is only 1,000 metres and the deep waters, admittedly recruited from the "cold wall", are certainly moving in spring, these charts cannot be regarded as defining the bottom limit of the currents indicated. The *Challenger*, in fact, at st. 37 in April found a south-east undercurrent at Bermuda from 200 fathoms down to 400 fathoms (350–750 metres) moving at a rate of about ½ mile per hour above and 1/10 mile below. Such a current would require at least two months to bring water to Bermuda from the water-parting off Cape Hatteras, but it may well have been twice or three times as strong during the climax of the May flood.

It is also noteworthy that exactly abreast of Jacobsen's water-parting (vortex ?), but on the landward side of the Gulf Stream, lay the *Bache* station 158 and the *Dana* station 1349 (the former in lat. 36° 12′, long. 74° 25′, the latter in lat. 36° 16′, long. 74° 33′), which presumably reveal the relations of the coastal waters to the Gulf Stream in February and May respectively. In February, Bigelow found an isolated 'tongue' of water of temperature 11°–12° and salinity less than 35·2 per mille dipping down from the surface like a 'waterfall' over the edge of the continental shelf to a depth of some 300 metres, and separated from the Gulf Stream by a nearly vertical wall of water 500 metres deep, of 35·5–36·0 per mille salinity. In May the *Dana* found this wall, from

200 metres downwards, bent outwards as an inclined plane, beneath which the mass of coastal water, *colder and less saline throughout than in February* 1914, was completely continuous (except the most superficial stratum less than 35·0 per mille) with the intermediate layers of the Gulf Stream column. At 300 metres the temperature and salinity at the *Bache* station were 11·4° and 35·19 per mille; at the *Dana* station in May they were down to 8·17° and 35·08 per mille. At the *Dana* station 1351, in the Gulf Stream itself, water with approximately this temperature and salinity lay 600 metres deep. At Bermuda at the same time it lay at 900 metres.

There can indeed be little doubt, after comparing these facts and the illuminating sections* provided in their respective reports by Bigelow (1915, figs. 11, 12, and 49), Nielsen (1925, Section 4), and Jacobsen (1929, fig. 11), *that during the flood period in spring the pent-up coastal waters are incessantly mixing with the left side of the Gulf Stream, to pass through it in part, and for the rest to be swirled eastwards into the general circulation of the Sargasso Sea* (cf. Jacobsen, p. 19). Iselin also, in a preliminary forecast of *Atlantis* results, has remarked of the Gulf Stream: "Very little of the Gulf water remains when Cape Hatteras is reached. The current is of course continuous, but gradually the Gulf of Mexico water becomes replaced at all depths by Sargasso Sea water *or a mixture of this and Slope Water*" (1933, p. 231).

Altogether, in spite of the fragmentary data on which it necessarily rests at present, the case for a seasonal cycle in the Sargasso Sea and its dependence on the periodic release of ice-bound coastal water seems unmistakable. The interest of the relation is practical as well as theoretical, for it opens up at once the prospect of our ability to attack the 'Atlantic Water' problem from a new and much more promising angle. The periodic incorporation into the intermediate layer of the Sargasso Sea of millions of tons of alien water must result in a periodic eastward spreading of the whole water mass. Annual variations in the amplitude of the extension may well be concerned in determining the irregularities of Atlantic incursions upon the coasts of Europe. If this argument is sound, the first step should obviously be to confirm the periodicity at Bermuda by regular observations at much more frequent intervals, especially from December to May, so as to date the changes with greater precision, and over a period of years sufficient to include the greater annual fluctuations. Only at Bermuda is such a continuous record practicable. Unfortunately, we have missed the opportunity of recordthe effects on the Sargasso Sea of the great frost and floods of the last American winter.

* A temperature section from *Atlantis* data given by Iselin (1933, fig. 2) for the same region in February cannot readily be compared owing to lack of isohalines. It is noteworthy, however, that the isotherms are shown appreciably lower than in the *Dana's* sections for May, *though with less difference than at Bermuda.*

In conclusion, my thanks are gratefully tendered to Dr. E. J. Allen, of Plymouth, Mr. Donald Matthews, of the Admiralty, Dr. J. N. Carruthers, of Lowestoft, and Mr. A. J. Clowes, of the *Discovery* Expedition, for help in getting access to relevant literature.

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# The 'Specific Action' of Ultra-short Wireless Waves

By Prof. W. E. Curtis, F.R.S., Dr. F. Dickens, and S. F. Evans

DURING the last ten years or so many investigations have been made concerning the biological and medical effects of short wave radiation. The absorption of such radiation by tissues necessarily results in the liberation of heat, and many of the effects observed are admittedly due to this cause. They could alternatively be produced by other methods of heating, although the radiation method frequently offers special advantages and potentialities. It is being pursued energetically in various laboratories and clinics, and appears to rest on a sound theoretical and experimental basis[1].

The literature of the subject, however, contains frequent references to other effects, usually termed 'specific', in the sense that they can only be produced by the short-wave method, that is to say, that they are not primarily thermal in origin. In some cases also it is claimed that the effects are restricted to certain wave-lengths, or that an optimum wave-length exists. So far as is known at present, from physical and chemical evidence,

radiation of these wave-lengths (3–15 metres) is not directly convertible into atomic or molecular energy, and such observations, if substantiated, would be of great interest and importance. We have therefore thought it desirable to scrutinise the evidence rather carefully, tracing the various references to their sources, and attempting, where possible, to repeat the experiments in question.

The effects claimed are diverse in character, including metabolic changes in tissues, physical changes in liquids and colloids, decolorisation of dyestuffs, bactericidal action and so forth. The one feature common to them all, we find, is the absence of any incontrovertible proof of their existence, and this in spite of their unquestioned acceptance by numerous authors of reviews and research publications. The details which follow should serve to expose the very unsatisfactory situation which exists at present, and perhaps to stimulate further investigation of the alleged phenomena.

(1) As an instance of effects which are probably due to the inadequacy of the precautions against heating, we may take the results of Reiter[2], who claimed to have established the existence of an immediate destructive action on the metabolism of malignant tissue when exposed to radiation of wave-length 3·4 metres. In attempting to repeat these observations*, we found that to maintain approximate constancy of temperature it was necessary to take much more drastic measures than Reiter appears to have done. For example, in order to keep the tissue contained in a suitable vessel, at 40° C., it had to be immersed in a bath containing liquid paraffin at 6° C. Under these conditions, no effect on metabolism was observed[3] when the specimen was subjected to intense irradiation on a wave-length of 3·4 m.

(2) The importance of surface tension effects has been stressed by Schliephake and Compère[4], who claim to have observed a lowering of surface tension in certain colloidal solutions including blood and serum. They consider that although earlier observations might conceivably be explicable as heat actions, "it is already permissible to say that we have now obtained for the first time certain proof of the existence of an effect of ultra-short waves that cannot be explained by the action of heat alone". The experiments referred to were made by allowing serum and other liquids to run from a stalagmometer placed between the electrodes of a 6-metre transmitter, surface tension being measured in the usual way by counting the number of drops for a given volume. It is stated without supporting data that "even a rise of temperature of several degrees had no influence whatever on the drop formation", and also that any possibility of a heat effect was rigorously excluded by comparative experiments in which the drops were warmed by radiant heat. No details of field strength or of the concentrations of the reagents used are given, although Schliephake in his book[5] (p. 52) states that definite dilutions are necessary. We have attempted to repeat this work, but without success. The stalagmometric method of measurement of surface tension was found to be entirely unsuitable for this purpose, since the heating effect was very great and the temperature of the drops could not be measured with precision. Using the more accurate and convenient torsion balance method, which further allows the determination of the temperature of the mass of liquid, we were unable to find any effect whatever on the surface tension of serum, although an effect of the magnitude reported by Schliephake would have been readily detected. The field used was of such strength that in stalagmometer experiments the drops of serum were heated through about 5° C. in 10 seconds. The variation of surface tension in the short wave field has been referred to in the literature as the "Schliephake Effect" but, in our opinion, proof of its existence is entirely lacking.

(3) Some further examples of specific action are given by Schliephake in his book. Working with Recknagel, he claims to have observed changes in the viscosity and stability of colloids which are opposite to those caused by rise of temperature. Only sixteen lines of description of these fundamental phenomena are given, and in reply to a request for fuller information it was learned that this could not be given "on personal grounds".

(4) Of particular therapeutic interest are the claims put forward in respect of bacteriological effects. Haase and Schliephake[7] claim that they have demonstrated killing of staphylococci and tubercle bacilli by exposure at body temperature to short wave radiation; Recknagel and Schliephake[8] report a marked reduction of the activity of diphtheria antitoxin following similar treatment, and attention is directed to the confirmatory work done by Szymanowski and Hicks[8]. In a paper[9] published six months later, however, Szymanowski and Hicks withdraw their earlier results on toxin and also report that, repeating the work of Schliephake and Haase on staphylococci, they were unable to establish any effect of the high-frequency field. They conclude that "the consistently negative results reported in this paper lend further evidence to the belief that the only direct therapeutic action of ultra-high frequency radiation is related to the problems of conductivity in tissues and consists in an elevation of temperature". In his book Schliephake does not refer to the latter paper.

* On behalf of the British Empire Cancer Campaign.

(5) A book on "The Foundations of Short-Wave Therapy" by Holzer and Weissenberg[10] has recently appeared. These authors are vague in their references to 'specific actions', but refer to colour reactions, notably decolorisation of the dye pinacyanol in a short-wave field[11]. As this appeared to be a simple and striking example of the effect of short waves, we attempted to repeat it in our laboratory, but without success, and we are informed in a personal communication from Dr. Holzer that he has since been unable to reproduce the effect.

(6) Another similar example which we unsuccessfully attempted to verify is Esau's observation, quoted by Pflomm[12], that turpentine oil could be hardened by exposure to a short-wave field ; no details were available, and although we have asked Prof. Esau for fuller information we have as yet received no reply. Still more mysterious are the effects on operators of short wave appliances reported by both Holzer and Schliephake. The precise nature of these effects appears somewhat indefinite, but their principal manifestations are psychological and can be prevented by suitably screening the apparatus. The present writers, working on 3 metres with totally unscreened apparatus using a power much greater than that quoted by Schliephake, have failed to notice any effects following daily exposure, and they have been informed by research engineers working with very high power on ultra-short wave-lengths that such effects are unknown in their experience.

(7) One of the most promising lines of attack would appear to be the investigation of anomalies in dielectric constants at these frequencies, with a view to possible correlation with dipole moment phenomena. Hausser[13] has published work in which such effects were observed for sphingomyelin at a frequency corresponding to a wave-length of 5 metres. This example, if confirmed, would constitute the nearest approach to the clear demonstration of a specific effect yet made ; it is therefore of particular interest, though it appears from personal communication with the author that the position is not yet cleared up to her entire satisfaction. In any case its relationship, if any, to the spectacular effects claimed by the more enthusiastic protagonists of specific short-wave actions is still obscure.

We believe that, with the exception of the last example, the above selection of experiments and observations is typical of those upon which the hypothesis of a specific action has been built. If such an effect exists, it should be possible for the discoverers to describe at least one clear-cut experiment which could be repeated by other workers. In the absence of such evidence we consider that the great mass of inconclusive observations which has been presented is a very insecure foundation for the rapidly growing belief in specific short-wave therapy. Whilst the possible existence of specific actions of ultra-short waves cannot be denied, in our opinion such effects have not as yet been adequately demonstrated. We therefore find ourselves in agreement with the conclusions of a recent report to the Council on Physical Therapy of the American Medical Association, by Mortimer and Osborne[14] :

"There is no conclusive evidence from the literature nor were we able to substantiate the claim of specific biologic action of high frequency currents (short-wave diathermy). In our opinion the burden of proof still lies on those who claim any biologic action of these currents other than heat."

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# Obituary

## Prof. W. E. Dalby, F.R.S.

PROF. WILLIAM ERNEST DALBY, emeritus professor of engineering in the University of London, who died at his home at Ealing on June 25 at the age of seventy-two years, received his practical training in engineering in the Stratford locomotive works of the Great Eastern Railway, and afterwards at the L. and N.W.R. works at Crewe. His duties at Crewe afforded him exceptional facilities for gaining experience in all branches of engineering work, and in construction and maintenance of both permanent way and locomotive. In 1894 he was at the University of Cambridge as assistant to the late Sir Alfred Ewing, who was then developing a Department of Engineering in that University. He left Cambridge to become professor of mechanical engineering and applied mathematics at the Finsbury Technical College, and in 1904 he succeeded the late Prof. W. C. Unwin as University professor of engineering at the Central Technical College, South Kensington. When that College was incorporated in the Imperial College of Science and Technology as the City and

Guilds (Engineering) College in 1907, he was made a member of its governing body and remained so until his retirement from the professorship in 1931. He was Dean of the City and Guilds College from 1906 until his retirement, and at the jubilee celebrations of the College in 1934 he was elected honorary fellow of the City and Guilds of London Institute.

Prof. Dalby served as dean of the Faculty of Engineering in the University of London for four years and as senator for eight years. He was elected a fellow of the Royal Society in 1913, was for some years vice-president of the Institution of Mechanical Engineers, and at the time of his death was a vice-president of the Institution of Civil Engineers. The Institution of Naval Architects also elected him honorary vice-president. He was president of Section G (Engineering) of the British Association in 1910, and was a member of some of that Association's research committees, notably the Gaseous Explosions Committee. During the Great War, Prof. Dalby served on several Government committees, and carried out much confidential research work for all three of the fighting Services. Of the many committees on which he served during the War and afterwards, mention may be made of the Board of Invention and Research, the Engineering Section of the War Committee of the Royal Society, for which he acted as secretary, and the Bridge Stress Committee.

It was only natural that Prof. Dalby's close connexion with railway problems during his service at the locomotive works should direct his attention to the many mechanical problems that arise in steam engine practice, and in the earlier part of his professional career his interest was largely centred on such problems. Towards the end of the nineteenth century, the demand for increased speed of engines brought into prominence the closer study of the methods of balancing rotating and reciprocating masses of engines. Prof. Dalby devoted considerable attention to this problem, and at the spring meeting of the Institution of Naval Architects in 1898 he described a new method which he had devised of solving balancing problems. The advantage of his method was that, by using a 'reference plane', the problem was reduced to one of graphical vector addition. This method he developed in his book "Balancing of Engines", which was first published in 1902. It has received such wide acceptance and has been so generally adopted that its authorship is in danger of being forgotten. In the latest edition of this work (1929) the author rightly states in the preface that his method "has found its way into textbooks with *and without* acknowledgment". Designers of high-speed engines are indebted to Prof. Dalby for so clear and simple a method of solving their balancing problems, and these problems are also not without interest for civil engineers, as the Report of the Bridge Stress Committee conclusively shows. In 1906 he published his second book on engine mechanism, namely, "Valves and Valve Gear Mechanism".

In connexion with the British Association's Gaseous Explosions Committee, Prof. Dalby was associated with the late Prof. H. L. Callendar in attempts to measure directly the temperatures inside the cylinders of gas engines. The method they employed required accurate indicating of the engine, and as the optical indicators then available were not sufficiently accurate for their purpose, Prof. Dalby improved on the design and produced the 'Dalby Watson optical indicator', which gave remarkably fine and accurate indicator diagrams.

Prof. Dalby was not slow to realize that such an indicator would prove invaluable in the rapid testing of materials, and shortly afterwards he designed his 'optical load extension recorder'. In this instrument he measured the load on the test specimen by the elastic extension of a hollow steel weigh-bar, the small elastic extensions being magnified optically to any desired scale. A photographic record of a load extension test could thus be obtained. Inertia effects in such an instrument being practically eliminated, test pieces could be rapidly loaded without sacrifice in accuracy of measurement. To effect such rapid loading he designed a special hydraulic testing machine, and thus he obtained a load extension diagram of a test-piece broken in one second of time. The instrument is described in several papers contributed to the learned societies and also in his book published in 1923, "Strength and Structure of Steel and Other Metals", wherein will be found records of researches carried out by its use.

The largest of Prof. Dalby's publications was "Steam Power". It was published in 1915 and brought into one volume comprehensive studies of steam plants, the properties of steam and the various dynamic and other problems associated with such plant. His last book, published in 1931, was entitled "Power and the Internal Combustion Engine". In addition to the five books mentioned above, he was the author of numerous papers contributed to learned societies and institutions.

In his teaching and lecturing, Prof. Dalby was clear in exposition and could make attractive any subject he presented to his audience. He was wholeheartedly interested in his profession, and his enthusiasm was an inspiration to those who were associated with him. His work at the College and for the many committees on which he served left him little time for recreation, and that recreation he often sought in change of work, for he was always happy at his drawing board designing or improving apparatus for conducting his researches. The many students who have come under his influence, and the wider circle of those who have read his publications or listened to his lectures, will regret the passing of one who has done much for the advancement of engineering science.

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WE regret to announce the following deaths:

Dr. H. J. Hansen, of Copenhagen, a foreign member of the Linnean Society of London, on June 26.

Prof. Julius A. Nieuwland, professor of chemistry in Notre Dame University, U.S.A., known for his work on synthetic rubber and lewisite, on June 11, aged fifty-eight years.

# News and Views

## Royal Society of Edinburgh: Honorary Fellows

THE following have been elected British honorary fellows of the Royal Society of Edinburgh: Sir Charles Boys; Sir Henry Dale, director of the National Institute for Medical Research; Prof. F. G. Donnan, professor of chemistry in the University of London, University College, London. Foreign honorary fellows have been elected as follows: Prof. L. H. Baekeland, honorary professor of chemical engineering, Columbia University, New York; Prof. M. Lugeon, professor of geology, University of Lausanne; Dr. George Sarton, editor of *Isis* and *Osiris*; Dr. G. L. Streeter, director of the Department of Embryology, Carnegie Institution of Washington; N. I. Vavilov, director of the Institute of Genetics, Academy of Sciences, Leningrad; Prof. W. M. Wheeler, emeritus professor of entomology, Harvard University.

## Dr. W. S. Bruce Memorial Prize

A COMMITTEE consisting of representatives of the Royal Society of Edinburgh, the Royal Physical Society and the Royal Scottish Geographical Society, has awarded the Dr. W. S. Bruce Memorial Prize to James W. S. Marr, who first went to Polar regions with Sir Ernest Shackleton in the *Quest* in 1921, sailing as a boy scout. On Shackleton's death, the expedition continued under Commander Worsley into the Weddell Sea. Marr next sailed with Commander Worsley in 1925 to Spitsbergen and White Island in the Algarsson expedition. In 1927 he joined the staff of the R.R.S. *Discovery* and since then, with brief intervals at home, he has spent his time in the Southern Ocean, partly in the old *Discovery* and partly in *Discovery II*. From 1929 until 1931 he was in *Discovery* when she was lent to Sir Douglas Mawson for the British-Australian-New Zealand Expedition which found many new stretches of the coast line of Antarctica. Last year Marr published in the "Discovery Reports" a large monograph on the South Orkney Islands, which extended the original researches of Dr. W. S. Bruce on that Antarctic Group.

## Dr. F. G. Novy

DR. FREDERICK GEORGE NOVY, formerly professor of bacteriology and dean of the Medical School of the University of Michigan, was presented with the 250,000th microscope produced by Messrs. Bausch and Lomb at a luncheon given to members of the American Association for the Advancement of Science during its summer sessions at Rochester, New York. Dr. Novy was selected for this honour by the executive committee of the American Association, for outstanding research in the field of bacteriology and immunology. He discovered and isolated the *Bacillus Novyi*, the agent of gas gangrene; he was the first to culture *Trypanosoma Lewisi*, and is the discoverer and isolator of *Spirochæta Novyi*, the cause of American relapsing fever. He has also made notable contributions to the study of filterable viruses, the respiratory processes of bacteria, and the causes of diphtheria, yellow fever and bubonic plague. A student of both Koch and Pasteur, Dr. Novy has the distinction of being the only person in the United States to-day who studied under Pasteur. France has made him a Chevalier of the Legion of Honour; Czechoslovakia created him a member of the Order of the White Lion, and Sinclair Lewis has romanticized him in his book, "Arrowsmith". For nearly fifty years, Dr. Novy was a member of the Medical Faculty of the University of Michigan, and is almost the last of the distinguished group gathered together by the late Dean Victor C. Vaughan. Dr. Novy's address at the luncheon, on "Some Results of Microscopic Research of Specific Significance for Human Welfare", was preceded by brief addresses by Dr. Edwin G. Conklin, president of the American Association, Herbert Eisenhart, president of Bausch and Lomb, and Dr. Edward Bausch who presented the 250,000th microscope of the company. It was Dr. Bausch's fifty-ninth year as a member of the Association.

## The Use of Knowledge

IN his address at the graduation ceremony of the University of St. Andrews on June 26, Sir James Irvine, referring to the way in which new knowledge is being acquired at a rate much faster than man's capacity to absorb it, and to the way in which the impact of changing conditions has caught us unprepared, suggested that the machinery of Government should include a 'Ministry of Knowledge', the functions of which would be to predict the repercussions of new knowledge on all phases of life. Through such an organization, it might be possible to frame in advance a national policy in which due regard is paid to such far-reaching problems as the future sources of energy, such fundamental questions as to whether our coal supplies are to be used merely for power or as raw material for manufactured products, or whether our forests will be utilized for the purposes for which they were planted or devoted to alternative uses already looming in sight.

UNDOUBTEDLY the rapid diminution almost to vanishing point of the lag between the origin of new knowledge and its application has left man with less time than ever to adapt himself to the repercussions of the new ideas he has evolved. The need for foresight and intelligent anticipation in such matters as the development of industry, transport and town-planning cannot be disputed. While Sir James Irvine's suggestion deserves serious consideration, it

is at least doubtful whether the existence of such organized knowledge thirty years ago could have spared the world much of the devastation of unemployment; or whether it is possible to plan in advance when conditions are rapidly changing. Apart from the difficulty of predicting with any accuracy the effect of scientific discoveries on society, the wise use of knowledge involved in planning requires not merely the use of existing knowledge to avoid mistakes committed in the past, but also adaptability, an enlightened opportunism and a readiness to examine all matters in the spirit and method of science. It is, however, a hopeful sign that leaders of scientific thought are to an increasing extent concerning themselves with the consequences of the application of scientific discoveries. Organizations such as the Scottish Development Council and the National Trust, cited by Sir James, already exist for the wise use or conservation of our national resources, and they deserve the support of all who are in any measure equipped to guide opinion and direct progress.

### Social Economics in the University of Manchester

THE Council of the University of Manchester has announced its decision to revive the second chair in the Faculty of Commerce and Administration, which has been in abeyance since 1932, with the title of "Chair of Social Economics". Mr. John Jewkes, who has been in charge of the Economics Research Section of the Faculty, which has been responsible for such important investigations as the industrial surveys of Lancashire and also Cumberland and Furness, undertaken for the Board of Trade, and the study of juvenile unemployment, has been elected to the chair as from September next. The duties will include the conduct of research and supervision of the work in the Economics Research Section, the creation of which was a new development in Great Britain in the organization of economic research within a university. It has now passed the experimental stage, and Mr. Jewkes's appointment is a recognition of it as an integral and permanent part of the work of the Department of Economics at the University of Manchester. Among a number of important inquiries which are in hand may be mentioned a study of the case histories of 2,000 juveniles in Lancashire who left school at Easter 1934; a study of the location of British industry, the changes proceeding and the forces behind them; a re-assessment of the industrial situation in Lancashire, being carried out at the invitation of the Lancashire Industrial Development Council; and a study of the systems of wage payment and labour conditions in the Lancashire cotton-weaving industry.

### Manganese and Plant Growth

MANGANESE is now recognized as an essential element for normal plant growth, and most soils contain sufficient of it in an available form to supply the needs of all vegetation. There are certain soils, however, mainly reclaimed swamp soils and soils with a very high calcium carbonate content, in which manganese is either not present in sufficient quantity, or not in an available enough form, to support the growth of certain crops. Characteristic diseases then result, of which the best known are the grey speck disease of oats, a disease of beet in Holland, chlorosis of spinach on Long Island and diseases of tomatoes and other crops on the Everglade soils of Florida, although in the last case deficiency of copper appears to be concerned as well as of manganese. The availability of the manganese in the soil is influenced to some extent by weather conditions and by cultural practices. In general, dry conditions aggravate the diseases, and also manurial treatments, such as liming, which tend to make the soil more alkaline. In Denmark a formula is now used, known as the 'manganese value' (Steenbjerg, Trans. Third Int. Congr. Soil Sci. Oxford, 1935), which is based on a determination of the exchangeable manganese by leaching with magnesium nitrate, and on a factor which is a measure of the energy displayed by the soil colloids in keeping the exchangeable manganese. It is advocated that the manganese value of a soil should always be determined before liming, especially in the case of sandy soils, so that a calculation can be made of the largest allowable increase in $p$H which would not entail danger of grey speck disease. In the same report, Gerretsen claims that the symptoms of manganese deficiency are largely the result of the absorption of toxic products from bacteria which multiply more profusely on the roots of manganese-deficient plants.

### Eastern Frontiers of the Roman Empire

SIR AUREL STEIN has made an offer to the authorities concerned to make a detailed survey of that part of the eastern frontier of the ancient Roman Empire which lies within Transjordania and Iraq. It will be necessary that a great part of this survey should be carried out from the air, as many of the sites are situated in the desert, and can be located only by this method. The proposal has the support of the British Academy and the Society of Antiquaries of London. It will form part of the scheme for the complete survey of the Roman Empire on a scale of 1 : 1,000,000, for which the British Ordnance Survey has already accepted its share of responsibility. The French have now completed the survey of that part of the frontier within the mandated territory of Syria. The survey was made by the French Air Force acting in conjunction with the Académie des Inscriptions et Lettres, and records observations of ancient roads, forts and defensive posts, as well as water supply. It is proposed that similar observations should be made in the survey projected by Sir Aurel Stein.

### Racial Elements in Sumerian Art

ARCHÆOLOGISTS at times may seem over-bold in attributing racial values to the terms of their cultural analyses, although the practice frequently has much to be said in its favour, when it is followed, with due reservation, as a convenient form of shorthand while a question of origins is still in suspense. Sir

Leonard Woolley's lecture on "The Racial Elements in Sumerian Art History" before the Royal Society of Arts on February 19 (*J. Roy. Soc. Arts*, **84**, April 3, 1936) afforded an example of the pregnant inferences to be drawn from study of the geographical distribution of cultural elements to be related to those found at Ur and kindred sites in Mesopotamia in its bearing on the solution of the racial problem in Sumeria. As he pointed out, various theories have been put forward at different times, as knowledge has grown, to interpret evidence of the physical characters of the early population of Sumeria. Sir Leonard himself, by citing specific elements which go to make up the complex of Sumerian art, was able to show that it is a compound of three cultural streams. Of these the Asianic or Iranian goes back at Ur to pre-diluvial times, its most marked characteristics there being the painted pottery, while it extends from Mesopotamia to China; a second is derivative from Anatolia and the third comes from northern Syria. In these three cultural elements he finds, hypothetically, a parallel to the distinction which is drawn in the evidence for three differentiated physical types in the population. In this instance, it is to be admitted, there would appear to be good ground for the view put forward that the brilliant achievement of Sumerian art, in which these cultural streams unite, was due to that cross-fertilization of racial strains, which Sir Leonard maintains lies at the root of all great achievements in the art of a people as a whole. It is to be expected that Sir Leonard's new field of exploration in northern Syria will throw further light on the racial as well as the cultural problem.

### Roman Leicester

EXCAVATION of Roman remains at Leicester now in progress has resolved an archæological doubt of long standing. While instructed opinion has hesitated between identifying the well-known Jewry wall, one of the highest surviving Roman walls in Britain, popularly regarded as a temple of Janas, as a Roman bath building, a basilica or even a town gate, it has now been shown, according to a report in *The Times* of July 4, to be part one of the external walls of the basilica in the forum of Roman Leicester, dating probably from about A.D. 100. A large part of the adjacent site, until recently occupied by a factory, is being cleared by the Corporation for the erection of public baths, and advantage has been taken of the opportunity to carry out these excavations. The base of the Jewry wall has been uncovered to some ten feet below the present surface, giving a total height of existing masonry of more than thirty-five feet. Two arched openings, previously thought to be doorways, are now revealed as windows. Beneath the Jewry wall, timber and masonry are associated with pottery and coins going back to the earliest Roman occupation of Britain. To the west of the wall is emerging a courtyard about 175 ft. wide, flanked by ranges of rooms or shops opening on to the courtyard by porticoes. This is the forum, of which the basilica forms part. Fronting the forum and abutting centrally on the basilica are the massive foundations of an architectural feature, probably once surmounted by a pediment, which dominated the forum and faced the main entrance. Outside the northern wall of the forum a stretch of cobbled roadway, deeply scored by wheels, has been uncovered. Massive walls and fragments of columns found on the factory site some years ago may now be identified as fragments of the forum and its colonnades. The road on the southern side of the forum is largely covered by St. Nicholas Street, near which is preserved one of the mosaic pavements for which Roman Leicester is famous. The excavations are being carried out by Miss Kathleen Kenyon under a committee, of which the Duke of Rutland is president, in co-operation with the Corporation of Leicester.

### Electricity Distribution in Great Britain

THE report of the Committee on Electricity Distribution has now been published (Ministry of Transport. London: H.M. Stationery Office. 2*s*. net). The chairman was Sir Harry McGowan, and Sir John Snell was a member of the Committee. The evidence, some of which was conflicting, has all been carefully considered, and definite recommendations are given which seem thoroughly justified. The Committee does not suggest nationalization or the setting up of a Distribution Commission. It advises a reduction in the present number of undertakings by amalgamating the smaller and less efficient stations with the larger ones. It is stated that any attempt to carry through a scheme of re-organization on a voluntary basis is bound to fail, and legislation must confer definite and adequate compulsory powers. The schemes of re-organization should make provision for the possibility of ultimate public ownership of all undertakings, including those not at present subject to purchase by the local authorities. It is proposed that no undertakings should be transferred compulsorily under a scheme of re-organization without a prior local investigation. To this end the Electricity Commissioners should be empowered to delimit the country into a number of areas and to appoint for each area a temporary district commissioner, with such technical and financial assistance as may be necessary. The district commissioner would bring under review all electric undertakings in his area. The Electricity Commissioners, after publishing a scheme and considering any representations, should be empowered to approve it and, if agreed, it should become operative at once.

WITH regard to the London and Home Counties Electricity District, which covers an area with a large number of undertakings, some with duplication of powers, many with differing systems and tariffs, and offering very unequal facilities, the criticisms recently made by the public are often justified. A substantial measure of amalgamation and co-ordination is possible and necessary. The present constitution of the London and Home Counties Joint Electricity and Authority should be brought under review. Complete standardization of systems and voltages should be the ultimate objective, but it is

difficult to see how this can be done equitably. The amalgamation of undertakings into a smaller number of larger undertakings is an important step towards standardization of methods of charging and more uniform prices. The Minister of Transport should be empowered to require all undertakers to offer an improved statutory two-part tariff for domestic supplies, *as an optional alternative to a flat-rate* charge. The fixed charge under an approved two-part tariff should be based either on the floor area of the house or on its rateable value, and all undertakers should be required to publish the actual scale of fixed charges under their two-part tariff. If these suggestions were adopted there should result a general, though necessarily gradual, reduction in costs. Amongst other recommendations, it is suggested that where gas and electricity undertakings are left under the joint ownership of a local authority, it would assist in the more rapid development of the electricity undertaking if the authority were required to have separate committees. Evidence was given which showed that restrictions had been imposed on the development of the electrical undertaking in order to prevent the financial position of the gas undertaking from being adversely affected. Both public activities should be equally untrammelled.

### Meteorology in India

IN the Report on the Administration of the Meteorological Department of the Government of India in 1934–35 (Delhi: Manager of Publications, 1935), an account is given of an important change in the arrangements for dealing with the increasing meteorological requirements of aviation along the trans-India air route. In previous years, a separate forecast had been issued to each aircraft in respect of the route covered by it each day from the forecasting centre concerned; but it became evident that it would soon be impossible for the two centres at Karachi and Calcutta to continue to do this for the four thousand miles of the route between Bahrein and Victoria Point. Arrangements were therefore made to broadcast forecasts for each section of the route regularly at fixed times, and to distribute data relating to upper winds and cloud height by wireless from pilot balloon stations along the trans-India route twice daily. The Agricultural Meteorology Branch carried out a number of researches, mainly at the Central Agricultural Meteorological Observatory, Poona; instruments for the study of micro-climatology were designed and tested, and a number of papers were written dealing with the correlation between meteorological conditions in the open and among growing crops; researches into evaporation, percolation and effective rainfall were also made. Experiments on the effect on soil temperature of a thin covering of soil of different colours and from different districts showed that coverings of certain soils had a big effect on the climate of the soil beneath. Other investigations were made into the albedo of different types of soil and vegetation. The scheme of crop-weather precision observations was applied to wheat and jowar at Poona, to rice at Karjat and to bajri at Baroda. The study of frost damage and methods of preventing it was also included in this branch's activities. The Upper Air Observatory at Agra released seventy-seven sounding balloons with recording instruments, and nearly half of these were recovered.

### Physiology of Indian Crop Plants

FOR some time past, the staff of the Institute of Agricultural Research of the Benares Hindu University has been engaged, under the leadership of Prof. B. N. Singh, in detailed and comparative studies of the physiology of Indian crop plants. A considerable number of publications on this subject has now been issued, mainly in the *Proceedings of the Indian Academy of Sciences*, and good progress has evidently been made in a highly interesting and important field of work. The most extensive work completed is that dealing with photosynthesis under different conditions of light, temperature and carbon dioxide supply. Since a large part of previous research on this subject has been carried out in temperate climates, it will be obvious that detailed studies of tropical plants are likely to be of considerable value. One striking result of this work is that tropical plants are found to have a higher light requirement in photosynthesis than similar species grown under temperate climatic conditions. Another especially interesting problem under investigation is that of the differences in respiration rate found to exist in plants differing in their duration of life. Short-lived plants are apparently characterised by a low respiration rate, which also falls off very rapidly as the age of the plant increases. Long-lived plants, on the other hand, not only have a high respiration rate but also are able to maintain this higher rate throughout life. Other subjects under investigation by comparative methods include the water requirements of seeds possessing different structural and biochemical properties, and the effects on plant growth of irradiating seeds with X-rays.

### Electricity in Horticulture

ELECTRO-CULTURE has to take into account the effects of electric heating, electric lighting and the voltage stress on the life of plants. The first application of electricity took the form of high-voltage discharges produced in close proximity to various plants in an endeavour to obtain artificial stimulation. In the Engineering Supplement for May of *Siemens Magazine*, a survey is given of recent developments, and the photographs shown of the effects produced are convincing. It has often been noticed that an increased growth of crops sometimes occurs during thundery weather. In the Arctic, where the average atmospheric potential gradient is high, it has been observed that the growth of vegetation during the short summer is more vigorous than in southern climates. Experiments have been carried out on cereals, potatoes, beets, tomatoes, strawberries and raspberries, and increases up to forty per cent have been obtained. Electricity in the form of light was the next application in the aid of horticulture. For vigorous plant growth a minimum of about 4 hours

of sunshine and altogether about 10 hours of daylight per day are required. As an example of the effect obtained by providing lighting for 10 hours each night with an illumination of about 4 foot candles, pansies after 83 days gave an average of approximately 16 flowers per plant as against 2 flowers for unlighted plants; and asters after 157 days' treatment bloomed 33 days earlier than usual. The red-yellow rays accelerate growth by stimulating the chlorophyll and the absorption of carbonic acid. Electric cables are also described which are used for heating the soil, and excellent economical results have been obtained.

### Ancient Heating and Lighting Appliances

ONE of the world's largest collections of heating and lighting appliances has recently been presented to the Smithsonian Institution together with an endowment for its maintenance. It begins from the fire drills with which primitive peoples started a flame by friction, and goes on to some of the latest appliances for lighting and heating. A description of the collection has been issued by the Smithsonian Institution. After the fire drill, the account passes to the percussion method, in which a hard stone, such as flint, gives a spark when struck against steel. The steel used was frequently made in an artistic form, and was called a 'briquet'. Some of these briquets dating from about A.D. 500 were unearthed in a farm in France in 1902. One specimen is inlaid with gold, and has bits of ruby-coloured glass embedded in it. There are also pistol-action lighters, which employ the principle of the flint and steel but simplify it by means of a trigger. This way of starting a fire came into general use about 1700, and was developed from the flint-lock gun, the first of which appeared in England about 1626. Illustrating the period preceding matches, when light was obtained by chemical action, the collection contains a Döbereiner jar, introduced about 1823. Flame was produced by letting hydrogen come into contact with certain other substances. The lamps range from one about the size of a thumb to another as tall as a man. The latter was obtained from a Buddhist temple. Another curiosity is a rolling lamp which was used at Hindu weddings; the light remains upright when the globe is rolled along the ground. There is also a horological lamp which tells the time of night by the amount of oil consumed.

### Anti-Vivisection Finance

THE honorary treasurer of the Research Defence Society, Sir Leonard Rogers, in a recent issue of the *Fight Against Disease* (24, No. 1) directs attention to the sums spent on propaganda by anti-vivisection societies within recent years. Analysing the certified annual accounts from 1912 onwards, and making allowance on one side for missing reports, and upon the other for useful work for animals done by some societies, it is estimated that a sum of approximately £600,000 has been received for 'anti-vivisection' work, and nearly £500,000 expended. The success in raising funds, in spite of the verdicts of two Royal Commissions against them, would appear to be partly due to a facile appeal to sentiment, aided by the lack of adequate medical and scientific knowledge of the masses to enable them to sift the 'anti-' statements. Anti-vivisection propaganda has sought to curtail the work of hospitals and veterinary colleges, and the one piece of useful work that might have been accomplished with the huge accumulated funds, the support of the 'Anti-Vivisection Hospital' at Battersea, has been allowed to lapse.

### Prevention of Disease in the Tropics

A MEETING of the Industrial Advisory Committee of the Ross Institute (London School of Hygiene and Tropical Medicine) was held on April 16 under the chairmanship of Mr. G. H. Masefield, when reports were received upon the Institute's activities in India, Ceylon, and South, East, and West Africa. Malaria prevention has received much attention, and instances were given of the value of mosquito control in combating this disease. Other diseases, including yellow fever and the eye-fly pest of India and Ceylon, were also discussed. Allusion was made to the value of reinforced aluminium foil as a heat insulator; in a tea factory in Ceylon a reduction of temperature of 7° F. at noon in the rolling room had been obtained by its use.

### British Medical Association: Annual Meeting

THE one hundred and fourth annual meeting of the British Medical Association will be held in Oxford on July 17–25, under the presidency of Sir E. Farquhar Buzzard, regius professor of medicine in the University of Oxford. The meeting will be divided into the following sections under the presidents indicated: Medicine (Dr. A. G. Gibson); Surgery (Prof. G. E. Gask); Obstetrics and Gynæcology (Prof. H. Beckwith Whitehouse); Ophthalmology (Dr. P. E. H. Adams); Pathology and Bacteriology (Dr. E. W. Ainley Walker); Anatomy (Prof. W. E. Le Gros Clark); Diseases of Children (Dr. R. C. Jewesbury); Neurology and Psychological Medicine (T. S. Good); Orthopædics (G. R. Girdlestone); Oto-Rhino-Laryngology (L. Golledge); Pharmacology and Therapeutics, with Anæsthetics (Prof. J. A. Gunn); Physical Medicine (Dr. W. J. Turrell); Physiology and Biochemistry (Prof. R. A. Peters); Radiology (R. H. Sankey); Tuberculosis (Dr. W. Stobie); Dermatology (Dr. S. E. Dore); History of Medicine (Dr. A. Chaplin); Medical Sociology (Sir George Newman); Nutrition (Dr. A. F. Hurst); Public Medicine (Dr. W. M. Willoughby). A popular lecture, entitled "Anthropology and Medicine", will be delivered on July 24 at 8 p.m. by Dr. R. R. Marett. In addition to the usual professional exhibitions, an exhibition of pictures illustrating the history of Oxford medicine will be open at the University Museum from July 20 until July 25. Further information can be obtained from the Secretary, B.M.A. Office, The Cottage, Keble Road, Oxford.

**Announcements**

AT the annual meeting of the Royal Anthropological Institute, the following officers for the year 1936–37 were elected. *President:* Dr. H. S. Harrison; *Vice-President:* Dr. H. J. Fleure; *Hon. Secretary:* Dr. R. W. Firth; *Hon. Treasurer:* H. Coote Lake; *Hon. Editor:* R. U. Sayce. The Rivers Memorial Medal for 1936 was awarded to Prof. Peter H. Buck (Te Rangi Hiroa) for anthropological work in the allied fields of New Zealand, Central and Eastern Polynesia. The Wellcome Gold Medal for 1935 was awarded to Dr. Lucy Philip Mair for an essay entitled "An Anthropologist's Estimate of African Policies".

THE following appointments in the Colonial Service have recently been made: P. F. Mason, to be assistant conservator of forests, Nigeria; J. C. K. McElderry, to be assistant conservator of forests, Nigeria; M. L. Pattullo, to be assistant conservator of forests, Nigeria; R. G. M. S. Macgregor, to be professor of physiology, Malaya; W. Orr, to be veterinary officer, Malaya; A. L. Craig-Bennett, to be chief fisheries officer, Palestine; A. H. S. Megaw, to be director of antiquities, Cyprus; F. P. Jepson, controller of plant pests and assistant entomologist, to be deputy director of agriculture, Ceylon; D. E. Wilson, medical officer, to be pathologist, Medical Department, Tanganyika.

PROF. JEAN SABRAZÈS, professor of pathological anatomy and clinical microscopy in the University of Bordeaux, has been elected *Correspondant* for the Section of Medicine and Surgery of the Paris Academy of Sciences, in succession to the late Prof. Léon Fréderiq.

AN institute for the investigation of rheumatism, the first of its kind in Austria, has been founded at Baden near Vienna. A balneological investigation department will be added later. The honorary director of the institute is Prof. R. Ewald.

THE Soviet Government has decided to erect a monument to the late Prof. Pavlov as well as to name an institute after him and to publish his works in four languages. His brain is to be preserved in the Moscow Institute for Cerebral Research, and his widow is to receive a pension of 1,000 roubles monthly.

THE ninth International Dental Congress will be held in Vienna on August 2–8 under the presidency of Dr. Hans Pichler, and will consist of fifteen sections. Further information can be obtained from Mr. A. E. Rowlett, 165 London Road, Leicester.

THE prefecture of Tokyo is to found a museum of hygiene, the inauguration of which is to coincide with the celebration of the 2600th anniversary of the Japanese era in 1940. The Society of School Hygiene at Tokyo proposes to organize on this occasion a general meeting, and to undertake active propaganda in favour of school hygiene.

IN order to permit more time for the preparation of material, the First International Conference on Fever Therapy, originally arranged to be held in New York on September 29–October 23 (see NATURE, 137, 989, 1936), has been postponed until March 30–April 2, 1937. Further information can be obtained from Dr. William Bierman, 471 Park Avenue, New York City, U.S.A.

A COMPETITION was held some time ago by the 'EPIDOS' (International Association of Bone Glue Manufacturers) with the object of stimulating research in the increase and improvement of outlets for bone glue. Several promising ideas were put before the Association. A total sum of 30,000 Swiss francs was distributed to the winners of this competition. EPIDOS has decided to continue its investigations in this direction. It has set aside a certain sum for the purpose of encouraging research by those who will put forward interesting ideas for the use of glue, and also recompensing those with proposals already ripe for development. Further information can be obtained from the General Secretariat of the International Association, 40 Rue du Colisée, Paris.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A teacher of general elementary science and mathematics in the Technical College, Wolverton—The Principal (July 13).

A lecturer in mechanical engineering in the Walsall Technical College—The Director of Education, Education Offices, Council House, Walsall (July 16).

A head of the Applied Mathematics Department in the Rochdale Municipal Technical School—The Principal (July 16).

An assistant in the Science Department (zoology and botany) in the Barnsley Mining and Technical College—The Principal (July 18).

Two University demonstrators in anatomy in the University of Cambridge—Dr. Roughton, Department of Physiology (July 19).

An assistant lecturer in electrical engineering in the Imperial College of Science and Technology (City and Guilds College)—The Secretary, Imperial College of Science and Technology, Prince Consort Road, S.W.7 (July 24).

An assistant inspector (Grade 2) in the Aeronautical Inspection Directorate of the Air Ministry—The Secretary (S.2.d.), Air Ministry (July 25).

An assistant director of research in medicine in the University of Cambridge—The Regius Professor of Physic (August 1).

A general manager of the Dudley Zoo—The Secretary, Dudley Zoological Society, Ltd., The Earl of Dudley's Estate Offices, Dudley, Worcs. (August 1).

A University reader in mathematics in the Imperial College—Royal College of Science—The Academic Registrar, University of London, S.W.7 (August 21).

A professor of biology in the University of Otago—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (August 31).

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 81.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## The Corona during the Total Solar Eclipse of June 19

OUR small amateur party (Miss Gerasimova and I) had an opportunity of observing the total solar eclipse of June 19, from the eclipse camp at Ak Boulak (near Orenburg, U.S.S.R.). The expedition of Poulkova Observatory and that of Harvard University conducted their work there.

For taking photographs of the total phase, we had two reflecting telescopes equipped with parabolic mirrors, which were ground, polished and figured by myself. The installation was a most primitive one. No guiding mechanism was available; consequently, only short exposures (from half a second to one second) could be used in order to obtain good definition.

Atmospheric conditions were splendid, which was an agreeable surprise to us, since the weather was very poor during three preceding days. To see the eclipse, thousands of people gathered on the hill where the camp was situated. Many of them came from Orenburg and even from farther distant localities.

The magnificent panorama of the total eclipse was opened to our eyes at the expected moment. The sky became of deep steel tint with a conspicuous shade of lilac. Venus appeared on the right upper side quite close to the sun; between the two, Mars was clearly seen. The horizon was orange red. The singing of skylarks seemed louder in the profound silence.

The corona was unusually bright; it emitted apparently more light than the full moon. Its colour could be described as silvery and silky. The shape of the corona was typical of the period of high activity of the sun, and somewhat reminded us of a five-pointed star. Two prominences of a bright ruby colour could be easily seen by the naked eye at the edge of the velvety black disk of the moon.

The photograph reproduced here (Fig. 1) was taken directly in the focus of our six-inch mirror (140 cm. focal distance), and gives some idea of the appearance of the inner corona viewed through a low-power telescope; in reproduction it has been enlarged about 5 diameters. This photograph was taken shortly after the beginning of the total phase. A second was taken somewhat after the central moment, and the third a few seconds before the end of the total phase. Prominences are very conspicuous on all the photographs; the greatest of them attains the height of at least 100,000 km.

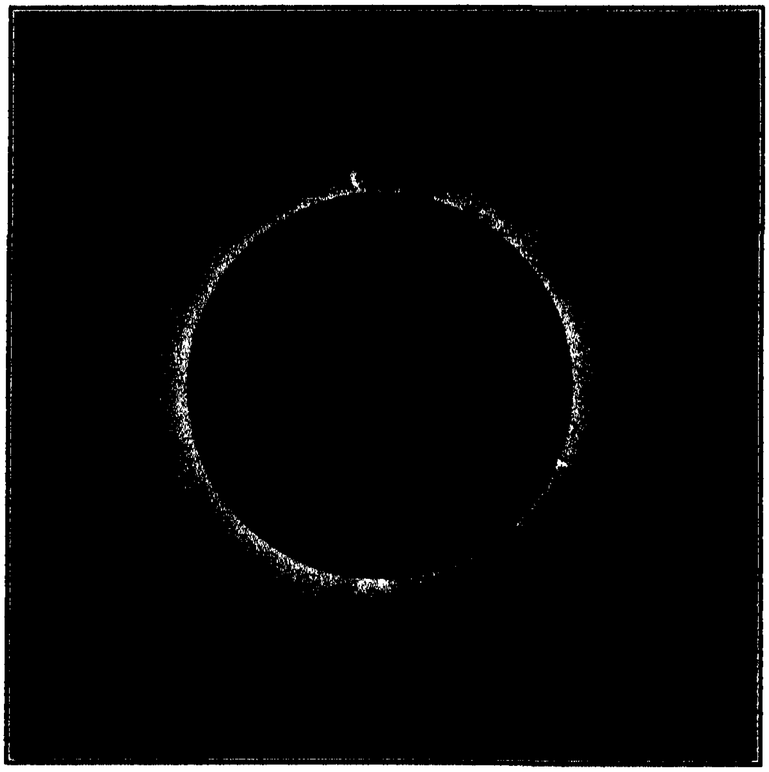


FIG. 1. Total solar eclipse of June 19, photographed at Ak Boulak.

The duration of the total phase was almost two minutes, a period of time sufficient for making more than three photographs, even with our primitive equipment. However, we were able to make only three exposures; the precious instants were gone surprisingly soon. This psychological effect should be undoubtedly attributed to great excitement caused by viewing this rare natural phenomenon.

Thanks are due to Prof. B. P. Gerasimovič, head of the Expedition, for admitting us to the Ak Boulak eclipse camp.

M. NAVASHIN.

Piatnizkaia 48,
Moscow.

## The Nature of Viscid Fluid Threads

THE considerations which follow gained the interest of Sir William Hardy, a specialist in such matters, when discussed with him briefly not a few years ago. As I am not aware of any record, at any rate in reasonably simple form, I venture to submit a brief statement.

The fact that permanent viscid threads can be pulled out of a plastic mass, after the manner of fibres of silk or of rayon before they solidify, does not lose its mechanical mystery through familiarity. If such a thread is suspended from one end, which oscillates up and down, it expands and contracts in length over a large range in dynamical unison with the oscillation, without breaking. The great amplitude may be imagined as due to the effective molecules being shaped like long dumb-bells, such as naturally interact mainly by force between their ends. If two rows of them lie parallel, there is a position of equilibrium when the ends are opposite each other. If one row is slid along, an elastic reaction comes into play which increases to a maximum, then diminishes as the attraction of the next pole becomes important, until it vanishes, when each attracted pole in the row is equidistant from the two influencing ones. This is an intermediate unstable position.

This peculiar complex type of viscid alternating elasticity holds a possible key to one type of phenomena: the expansion consists of rows of molecules within the threads sliding past one another, thus permitting reversible extension of large range without rupture in a way which we need not here follow in detail. The ruling idea came from the theory of the homologous hydrocarbon series provided by organic chemistry in its very early days, giving dumb-bell pictures which were then taken to be symbolic, but now under the scrutiny of X-ray diffraction reveal a geometrical reality.

A similar, but much less definite multiplication of basic molecular elements, is actually formed in hyper-molecules of substances of cellulose type, such as the plastic threads would require. But how is it that the parallel rows are not dispersed sideways from one another? Observe a hanging thread: it shrinks up at the free end into a spherical blob, like a dew-drop, obviously by surface tension holding it firm; higher up the length-wise surface tension has to hold up the lower part of the thread against its weight, while the transverse tension round the section holds the thread together. The section changes during an imposed vibration, the supporting force thus altering rhythmically as required. There is room for a mathematical theory here, if enough is known of the facts.

A somewhat cognate subject is the tension theory of the foreign monomolecular surface-layers discovered by Miss Pockels of Heidelberg and the late Lord Rayleigh, and developed extensively mainly by I. Langmuir and N. K. Adam. But one may insist that this effect is superposed on the Young–Laplace theory of an intrinsic surface tension at a pure interface and by no means replaces it.

One recalls also another cognate subject. Among my early recollections is the vision of Lord Kelvin standing, cup and saucer in hand, orating on the wisdom of the technique of the ladies' tea table, which spread a film of water in the saucer to prevent the cup of tea sliding over it. For, as he insisted, this brings a new type of intimate friction, entirely different from the smooth viscosity developed into hydro-dynamic theory by his friend and prophet Stokes, a theory which was to receive so vast expansion into the practical realms of ship-resistance and lubrication largely in the hands of Osborne Reynolds. All these topics, so simple in essence, now ramify very extensively throughout the most recent marvellous technology, with no slight reaction backward on abstract science.

JOSEPH LARMOR.

Holywood,
Co. Down.
June 13.

## Inactivation of Crystalline Pepsin

CRYSTALLINE pepsin, in solutions of constant ionic strength on the alkaline side of its stability maximum, inactivates unimolecularly at a rate which is inversely proportional to the *fifth* power of the hydrogen ion concentration. This unusual relationship has been demonstrated over a velocity interval of 1 to 5,000 in nearly a hundred kinetic experiments at two temperatures with four different buffers. The rate varies with the buffer, but the fifth-power relation does not. As the buffer ratios change by different amounts in the same $p$H range, general basic catalysis is therefore excluded. It is likewise improbable that simple hydroxyl ion catalysis determines the rate.

The dependence on ionic strength is striking. Between $\mu = 0{\cdot}012$ and $\mu = 0{\cdot}10$, the velocity at constant $p$H increases by more than thirty times, regardless of the mono-monovalent salt used. At higher concentrations the change is smaller and finally reverses. The effect is complex, since the curve relating log-velocity to $p$H is shifted along both axes. Various relations to acidity earlier described[1] are partly fortuitous, owing to failure to control ionic strength.

This description applies only when the solutions are not agitated. On shaking, a heterogeneous reaction, independent of $p$H and $\mu$ over wide limits, obscures the results. The fifth power appears only at $p$H above $6{\cdot}2$ ($\mu = 0{\cdot}1$), where the homogeneous reaction is rapid enough to predominate. In more acid solutions the half-period of the latter may exceed five years at 25°.

The large exponent probably indicates that equilibria governing the concentration of an unstable species of pepsin ion determine the rate. Five acid groups must dissociate in the formation of this ion; the dissociation of the strongest group must also be fairly small in this range of acidity. Pepsin contains a limited variety of widely-spaced acid radicals; thus, it is conceivable that the five groups are alike and possess nearly identical dissociation constants. If they differ only by limiting statistical factors, the failure of the fifth-power dependence to hold exactly at $p$H above $6{\cdot}45$ means that the dissociation constants are near $1{\cdot}7 \times 10^{-7}$. This is slightly stronger than the positively charged ammonium groups in the simpler polypeptides[2] and in a simple protein[3], and approximately correct if the free amino groups of pepsin come from cystine rather than lysine. There are probably just five cystine residues in the enzyme, but Herriott and Northrop find four rather than five primary amino groups in pepsin[4].

If account is taken of the effect of temperature on the size of the pepsin fraction present as the unstable ion, the temperature effect on the rate of the actual reaction (decomposition of this ion) is much smaller than the observed change in velocity. When the

ratio $k_{25°}/k_{15°}$ (about 30) is used to calculate the critical increment, the result is 64,000 calories—a high figure, characteristic of protein denaturation. When the shift in the $p$H dependence is allowed for (assuming all five groups alike) a quite ordinary value, 20,000 calories, is obtained. The exponent produces a large disparity, though the heat of dissociation of each group is only 9,000 calories. The latter value is favourable to the view that primary amino groups are involved, if the possible complications of tautomerism may be neglected. (Michaelis and Rothstein concluded that temperature changes only bring about changes in hydroxyl ion concentration. This unwarranted conclusion depends on the assumption that the inverse kinetic relation to hydrogen ions signifies a direct dependence on hydroxyl ions.)

Should this procedure apply to proteins generally, the statistical-mechanical difficulties arising from the great temperature effect in denaturation may prove to be illusory. The frequently observed variation of critical increment with $p$H, and its decline to a limiting value at high temperatures, can also be explained.

These measurements, to be described in detail elsewhere, owe much to the generous interest of Prof. J. N. Brønsted.

JACINTO STEINHARDT.
(National Research Fellow in Biology, and General Education Board Fellow.)
Institute of Physical Chemistry,
University, Copenhagen.
April 5.

[1] L. Michaelis and M. Rothstein, *Biochem. Z.*, **105**, 60 (1920); R. Ege, *Z. physiol. Chem.*, **143**, 159 (1925); A. M. Goulding, H. Wasteneys and H. Borsook, *J. Gen. Physiol.*, **10**, 451 (1926-27).
[2] E. J. Cohn, *Erg. d. Physiol.*, **33**, 781 (1931).
[3] K. Linderstrøm-Lang, *Trans. Far. Soc.*, **31**, 1 (1935).
[4] R. M. Herriott and J. H. Northrop, *J. Gen. Physiol.*, **18**, 35 (1934).

## The Nitroprusside Reaction as a Test for Reduced Glutathione

THIS test was first introduced by Mörner[1]. He added sodium nitroprusside and then alkali to cystein and obtained a deep purple red. This changed into a reddish brown and finally disappeared. Cystin gave no reaction. Mörner used a solution of pure cystein, and whether or not he heated his solution prior to the test he did not state. Heating in this case would not affect the results materially. In 1921 Hopkins[2] very casually suggested heating tissue in weak acetic acid in order to intensify the reaction before applying the test. This unchallenged suggestion has led other workers to heat tissues with acetic acid prior to the application of the test, thus obtaining wholly meaningless results (see, for example, Fink[3], Camp[4] and Coldwater[5]). In 1923 Harris[6] showed that native proteins which are non-reactive to nitroprusside become reactive when warmed with acid or base. For example, fresh ovalbumin is placed in three test-tubes and to tube *A* nothing is added; to tube *B* acetic acid is added; and to tube *C* acetic acid is added, and this tube is heated. All tubes are rendered alkaline with ammonium sulphate. The nitroprusside test is then negative in tubes *A* and *B* and positive only in the tube that was heated. Heat denatures proteins and liberates free $-SH$ radicals if the protein contains such in combined form.

Coldwater allowed tadpole tails to regenerate for 14 days, applied the nitroprusside test, and found that the regenerating part gave a more intense colour. I allowed tails of overwintering tadpoles (*Rana clamitans*) to regenerate for 3 weeks at 13°–16° C., keeping the animals without food. The tips, *C* (Fig. 1), of the tails were analysed quantitatively for GSH as soon as cut. After the elapse of the given time for regeneration (at the end of which the tails were less than half regenerated) regions *A*, *B*, and the regenerated region *R* were analysed for GSH. Two series of 35 tadpoles in each were analysed. The results are indicated in the accompanying table and are expressed in percentages of wet weight.

Per cent GSH of wet weight of different regions of a tadpole's tail

| Series | Region of tail *A* | *B* | (Regenerate) *R* | *C* |
|---|---|---|---|---|
| I | 0·028 | 0·024 | 0·021 | 0·025 |
| II | 0·033 | 0·021 | 0·016 | 0·030 |
| Average | 0·030 | 0·022 | 0·018 | 0·027 |
| Probable Error | ± 0·001 | ± 0·0006 | ± 0·001 | ± 0·001 |

It is clear that the regenerating area has a lower concentration of GSH than the non-regenerating muscular regions. If the bone present in the old portion of the tail were removed, or if the results were reckoned in terms of dry weight, the differences would have been even greater. These results, of course, in no way contradict any hypotheses put forward by others that the $-SH$ radical may be a factor in regeneration, since the amount of GSH necessary for muscle metabolism might be far in excess of the small amount required for regeneration. This work does show, however, the fallacious results obtained by heating tissues prior to the application of the nitroprusside test.

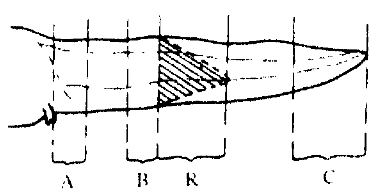



FIG. 1. Tail of *Rana clamitans* tadpole. *A*, *B* and *C* are the regions of the old tail analysed for GSH. *R* is the regenerating area.

The nitroprusside test was applied to pieces of *Euplanaria maculata* at different time intervals after cutting (2, 3, and 7 days). The initial result was an intense purple red throughout. Fading began in the lateral and regenerating areas of the reconstituting organism. If the permeability factor was not completely eliminated by acetic acid, then the areas shown to be more permeable to methylene blue stained first (that is, the lateral areas and the regenerating tissue). The other tissues stained later, but just as intensely, and the colour disappeared later. The intensity of colour was not at a maximum at the same time throughout the animal. Incidentally, it may also be mentioned that the nitroprusside reaction was applied to *Hydra grisea*. The immediate

result was an initial flash of colour of about equal intensity throughout. The colour in the tentacles and in the stalk faded out at a very definitely earlier period than that in the main body region. Prior to the test, the animals were chloretonised and were in an expanded condition. Coldwater's results can easily be interpreted as due to differences in penetration of the reagents in the regenerating and non-regenerating regions.

The specificity of the nitroprusside test for reduced glutathione in living tissues has also been questioned. Now Sullivan[7] noted that, apart from free cystein, substances giving a positive nitroprusside test are not present in normal tissues. These substances include acetone, ethyl aceto-acetic acid, and cyanacetamide. There is, moreover, no authentic record indicating the presence of free cystein in living tissues. Applying Sullivan's test for cystein, Tunnicliffe[8], Thompson and Voegtlin[9], Gregory and Goss[10] and I failed to find free cystein in living tissues. It may thus be concluded that the nitroprusside test is specific for reduced glutathione *when applied to normal living tissues and when ammonium hydroxide is used as the alkali and no heat is applied.*

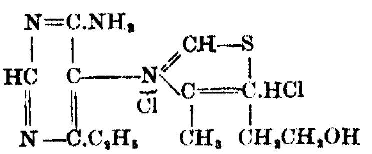
N. S. ROYSTON MALOEUF.

Zoological Laboratory,
Cornell University,
Ithaca, N.Y.

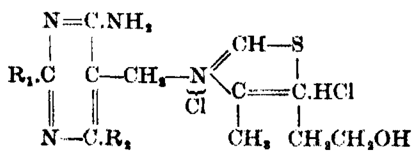
[1] K. A. H. Mörner, *Z. physiol. Chem.*, **28**, 595 (1899).
[2] F. G. Hopkins, *Biochem. J.*, **15**, 286 (1921).
[3] D. E. Fink, *Science*, **65**, 143 (1927).
[4] W. H. Camp, *Science*, **69**, 458 (1929).
[5] K. B. Coldwater, *J. Exp. Zool.*, **65**, 43 (1933).
[6] L. J. Harris, *Proc. Roy. Soc. Lond.*, B, **94**, 426 (1923).
[7] M. X. Sullivan, Publ. Health Repts. U.S., 41, pt. 1, 1030 (1926).
[8] H. E. Tunnicliffe, *Biochem. J.*, **19**, 194 (1925).
[9] J. W. Thompson and C. Voegtlin, *J. Biol. Chem.*, **70**, 793 (1926).
[10] P. W. Gregory and H. Goss, *J. Exp. Zool.*, **69**, 13 (1934).

## The Structure of Aneurin and Thiochrome

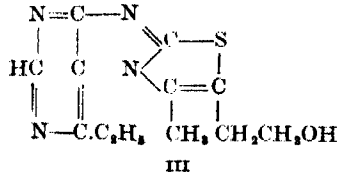
R. R. WILLIAMS has just published[1] a note on the structure of aneurin (vitamin $B_1$). From a study of degradation products of the vitamin, he concludes that his original formula (I)[2] for aneurin is wrong, and that it should be represented by (II: where $R_1 = CH_3$; $R_2 = H$); this new structure is similar in essentials to that suggested on theoretical grounds by K. Makino and T. I. Imai (II: where $R_1 = H$; $R_2 = CH_3$)[3].



I



II



III

For thiochrome, which is formed from aneurin by mild oxidation, we suggested on the basis of formula (I) the structure (III)[4]. In the course of subsequent synthetic work we observed that thiazpurines, prepared as models for a thiochrome synthesis, although blue fluorescent in ultra-violet light, never showed fluorescence in daylight. This led us to suspect that (I) might not represent aneurin, and our suspicion was confirmed on completing the synthesis of the compound having structure (I). The synthetic substance, though exhibiting similar colour reactions to aneurin, is not identical with it; on oxidation with potassium ferricyanide it gives a substance non-fluorescent in daylight, but blue fluorescent in ultra-violet light. The difference in fluorescence between thiochrome and synthetic thiazpurines suggests that the former contains a different ring system. Accordingly, the possibility that the formula of Makino and Imai might represent the vitamin has been explored by synthetic methods. These experiments are not yet complete, but a compound similar in structure to (II) has been prepared, which on oxidation with potassium ferricyanide yields a substance exhibiting an intense blue fluorescence comparable with that of thiochrome. We are thus of the opinion that aneurin has a structure of type (II).

Our results afford additional evidence in support of the formula (II: where $R_1 = CH_3$; $R_2 = H$) advanced by Williams as a result of his brilliant investigations. Final proof of the structure must rest with the complete synthesis of the vitamin itself.

F. BERGEL.
A. R. TODD.

Medical Chemistry Department,
University, Edinburgh.
June 29.

[1] *J. Amer. Chem. Soc.*, **58**, 1063 (1936).
[2] *J. Amer. Chem. Soc.*, **57**, 229 (1935).
[3] *Z. physiol. Chem.*, **239**, I (Feb. 28, 1936).
[4] G. Barger, F. Bergel and A. R. Todd, B., **68**, 2257 (1935).

## A Radioactive Isotope of Iron

IT was shown by Fermi and co-workers[1] that the activity induced in iron by neutron bombardment is due to an isotope of manganese. The isolation of an active iron isotope has not been reported. By means of the sensitive tube counter outfit[2] in this institute, it was found that active iron can be isolated from cobalt which has been irradiated with neutrons, whereas irradiated iron after removal of manganese was found to be inactive. Experiments were carried out with cobalt as metal, as oxide and as carbonate.

After activation, the substance was dissolved in nitric acid and a trace of ferric salt added to the solution. Iron was precipitated from acid solution by means of ammonium acetate, the hydroxide then dissolved again and precipitated once more in the same way, and finally the same process was repeated a third time. The final product ($Fe_2O_3$) showed an activity decaying with a period of very nearly 72 hours. As only a single cobalt isotope is present in detectable amounts, it can be deduced that this activity must be due to the isotope $^{59}_{26}Fe$. This result is in very good accordance with recent investigations on the isotopic constitution of iron[3], which have shown that the isotopes $^{57}_{26}Fe$ and $^{58}_{26}Fe$ are stable, being present in amounts of 2·8 and 0·5 per cent of the element. These data also explain why it has been impossible to detect the formation of an active iron isotope by irradiation of iron itself.

Attempts to isolate active zinc from irradiated gallium and active chromium from irradiated manganese gave negative results. The experimental method, however, only allows detection of active products with fairly long periods.

E. BUCH ANDERSEN.

Physical Institute,
University, Aarhus,
Denmark.
May 27.

[1] Fermi and co-workers, *Proc. Roy. Soc.*, A, **146**, 483 (1934).
[2] Buch Andersen, *Z. Phys.*, **98**, 597 (1936).
[3] de Gier and Zeeman, *Proc. Roy. Acad. Sci. Amsterdam*, **38**, 959 (1935).

## Determination of van der Waals Forces

THE quantum theory, unlike classical theory, predicts a finite effective collision area for impact between gas atoms attracting with a mutual potential energy falling off more rapidly with distance than the inverse cube. It has been pointed out by Massey and Mohr[1] that this makes possible a new experimental method for investigating the magnitudes and nature of these interatomic forces, namely, by direct observation of free paths by molecular ray methods using sufficiently high resolving power. Further, they have given a formula for the effective collision area for any inverse power law of force, from which the results of such experiments could be interpreted.

Since then, Rosin and Rabi[2] have carried out experiments under the required conditions for collisions of rare gas atoms with alkali atoms. The values of the van der Waals energy constant $C$ (such that the van der Waals potential energy of interaction of two atoms at distance $r$ apart is $-C/r^6$) for alkali – rare gas interaction, derived from their results, are given in columns $a$ of Table I. (In obtaining those results correction has been made for the random direction of motion of the scattering gas atoms, but not for the Maxwellian distribution of velocities.)

Table I

Values of $C \times 10^{60}$ (erg.cm.$^6$).

| | He | | Ne | | A | |
|---|---|---|---|---|---|---|
| | *a* | *b* | *a* | *b* | *a* | *b* |
| Li | 14·4 | 17 | 18·7 | 32 | 188 | 125 |
| Na | 17·8 | (26) | 40·4 | (51) | 192 | (200) |
| K | 31·7 | 35 | 50·5 | 68 | 356 | 260 |
| Rb | 25·4 | (40) | 49·0 | (77) | 249 | (290) |
| Cs | 29·5 | 44 | 56·7 | 87 | 235 | 325 |

These results are of special interest because they may be compared with values of $C$ derived from the polarisabilities of the atoms by a formula due to Hellmann[3]. The polarisabilities of lithium, potassium and cæsium have been measured directly by molecular ray methods by Scheffers and Stark[4] and those of the rare gas atoms may be deduced from measurements of their refractivities[5]. Substituting these values in Hellmann's formula, we derive the values of the constant $C$ given in columns $b$ of Table I. The bracketed values have been derived by interpolation, as the polarisabilities of sodium and rubidium have not yet been determined.

It will be seen that the agreement of the two sets of values of $C$ is quite good and suggests that the free path method will prove very convenient for the determination of van der Waals forces. Further experiments in this direction, particularly on mutual collisions between rare gas atoms, would therefore be most valuable. It might be mentioned in conclusion that the scope of the free path method is much wider than that of the older methods depending on gas viscosity and diffusion phenomena.

We would like to express our thanks to Miss R. Sullivan for assistance in some of the numerical calculations.

H. S. W. MASSEY.
R. A. BUCKINGHAM.

Queen's University,
Belfast.
June 2.

[1] *Proc. Roy. Soc.*, A, **141**, 434 (1933) and **144**, 188 (1934).
[2] *Phys. Rev.*, **48**, 373 (1935).
[3] *Acta Phys. Chim. U.S.S.R.*, **2**, 273 (1935).
[4] *Phys. Z.*, **35**, 625 (1934).
[5] C. and M. Cuthbertson, *Proc. Roy. Soc.*, A., **84**, 13 (1911).

## Bursts of Cosmic Radiation

BURSTS of cosmic radiation were observed in an ionisation vessel 14 cm. diameter and 27 cm. high, filled with carbon dioxide at 10 atmospheres pressure, and completely surrounded by 10 cm. of lead. The sizes of the bursts were estimated as ranging between 35 and 1,800 rays, while the average frequency was 0·88 per hour, with a maximum of four bursts occurring in any one hour.

The magnitude distribution of the bursts in a series of 2,640 observation hours could be represented by the expression

$$B = \frac{8 \cdot 3 \times 10^5}{R_2^{5/3} - R_1^{5/3}}$$

where $B$ = number of bursts (per 2,640 hours) containing between $R_1$ and $R_2$ rays ($R_1 < R_2$).

This is of similar form to that suggested by C. G. and D. D. Montgomery to summarise the cascade theory of bursts[1].

The average rates of burst production for various barometric pressure groups were :

| Barometer | Bursts/Hour |
|---|---|
| 685–695 mm. | $0 \cdot 911 \pm 0 \cdot 019$ |
| 695–700 mm. | $0 \cdot 840 \pm 0 \cdot 016$ |
| 700–710 mm. | $0 \cdot 811 \pm 0 \cdot 019$ |

The barometer effect thus amounts to approximately $-0 \cdot 75$ per cent per mm., or about three times as great as that observed here for the bulk of the radiation.

The frequencies with which 0, 1, 2, 3, or 4 bursts respectively occurred per unit period of 57 minutes could be represented by the successive terms of the expansion of the binomial $(q+p)^n$. The values of $q$ and $p$ were found to depend upon the barometric pressure as shown in the following table :

| Barometer | $n$ | $q$ | $p$ | $P$ | $N$ |
|---|---|---|---|---|---|
| 685–695 mm. | 4 | 0·211 | 0·789 | 0·32 | 934 |
| 695–700 mm. | 4 | 0·205 | 0·795 | 0·58 | 1251 |
| 700–710 mm. | 4 | 0·197 | 0·803 | 0·32 | 904 |

$P$ = the probability that the deviations between the observed and calculated values of the frequency could be caused by random sampling variations ($\chi^2$-test).
$N$ = total number of 57 minute periods of observation.

These results would be explained if the burst-producing radiation falling on the apparatus in the unit time of 57 minutes comprised only a few rays, namely, $n=4$, each of which had a relatively high probability, $q$, of generating a burst. The assumption that the burst-producing radiation falling on the apparatus is composed of a large number of rays, each with a very small probability of producing a

burst, would require that the distribution of the above mentioned frequencies be of the Poisson rather than the binomial type, and this was not supported by the observations.

An increase of barometric pressure brings about a decrease of $q$ with $n$ remaining constant, and this is in line with Swann's hypothesis[2].

A. R. HOGG.

Commonwealth Solar Observatory,
Mount Stromlo, Canberra.
May 8.

[1] *Phys. Rev.*, **48**, 786 (1935).
[2] *Phys. Rev.*, **46**, 828 (1934).

## Are Hymenoptera Tetraploid ?

A RECENT communication[1] has suggested that among Hymenoptera Symphyta males may be diploid, females tetraploid. It was further suggested that this characteristic might help to explain the phenomena of pre-conjugation as seen in *Apis* and *Cynips kollari*.

More light on the problem may be obtained by taking into consideration available genetic data. If the queen bee is a true tetraploid, one heterozygous for a given recessive factor might be designated *AAaa* and would be expected to produce impaternate diploid drones, an excessive number of which would show the dominant character (the exact ratio of dominants to recessives would rest upon the peculiarities of tetrad or octad formation). However, if the queen bee is diploid and heterozygous for a recessive factor, she would be designated *Aa* and would be expected to produce impaternate haploid drones, equal numbers of which would show the dominant or the recessive character.

Dzierzon, in 1854 (eleven years before Mendel's paper), stated that male offspring from a hybrid queen bee resembled one or the other parental race, the two types appearing in equal numbers. Newell[2] reports that hybrid queens resulting from crosses of yellow Italian and non-yellow Carniolan are themselves yellow and indistinguishable from the Italian parental stock, but "produce both Italian and Carniolan drones, produce them in equal numbers, and do not produce any other kind". A clearer demonstration of this genetic segregation is given by Michailoff[3]. A black-eyed bee, the mother of which was known to have produced white-eyed drones, herself produced a total of 811 white-eyed drones and 806 black-eyed. A black-eyed daughter of this queen, mated to a white-eyed drone, produced 191 white-eyed, 191 black-eyed females and 8 white-eyed, 11 black-eyed drones.

The same method of inheritance has been amply demonstrated by Whiting and his associates in the braconid, *Habrobracon*, for more than 100 mutant genes. Here females show 20 gonial chromosomes, males 10, and the possibility of a diploid–tetraploid condition is made improbable by the presence of one very small chromosome in the male, two in the female, as shown by Torvik-Greb[4] and verified by me. Moreover, recessive mutations in this species have so often been found in but a single male of a fraternity as to indicate that such mutations occurred shortly before maturation of the egg and were made visible by reason of the haploid condition of the offspring.

Also of interest in connexion with this problem is the fact that diploid males, which are occasionally produced in *Habrobracon* from fertilised eggs, show no synapsis of homologues during spermatogenesis and, behaving like haploid males, exhibit an abortive reduction division, resulting in diploid sperm.

Impaternate females likewise may appear in *Habrobracon*; these are diploid, and produce normal haploid sons. Recent cytological work indicates that these females come from unfertilised tetraploid eggs, and by inference, from tetraploid patches in the ovaries of their mothers. If the thelytokous mothers are heterozygous for any recessive factor, the impaternate daughters appear in the ratio of 3 dominants to 1 recessive[5], thus fitting the expectation for diploid progeny from tetraploid gonads.

Thus, although tetraploidy may be a characteristic of lower Hymenoptera, it is unlikely that this condition is normal among representative species of Apocrita. In all cases, genetic evidence would be desirable to back up the cytological findings, since by this means tetraploidy is readily demonstrable.

B. R. SPEICHER
(National Research Fellow in the
Biological Sciences).

Columbia University,
New York.

[1] F. Greenshields, NATURE, **137**, 662 (1936).
[2] W. Newell, *Science*, **41**, 218 (1915).
[3] A. Michailoff, *Z. I. A. V.*, **59**, 190 (1931).
[4] M. Torvik-Greb, *Biol. Bull.*, **68**, 25 (1935).
[5] K. Speicher, *Biol. Bull.*, **67**, 277 (1934).

## Bones of a Whale from the Wieringermeer, Zuider Zee

IN 1935, the hind part of a skull, two lower jaws and other bones of a juvenile whale were found in the soil of the Wieringermeer, a reclaimed part of the Zuider Zee. Dr. van Deinse and I came to the conclusion that these bones must have belonged to a young specimen of *Rhachianectes glaucus*. Close comparison of the bones with a skeleton of *R. glaucus* in the British Museum (Natural History) proved that our conclusion was a correct one. Mr. M. A. C. Hinton and Mr. F. C. Fraser are also convinced that our identification is right.

Nearly as interesting, however, is the fact that there are earlier records of this whale in Europe which seem to have been overlooked until now. As a matter of fact, the name *Rhachianectes glaucus* auct. must be changed to *Eschrichtius gibbosus* (Erxl.). Van Deinse and I propose to publish a detailed paper with full synonymy in the journal *Temminckia* in the beginning of 1937.

G. C. A. JUNGE.

Rijks Museum van
Natuurlijke Historie,
Leiden.

## Immunological Detection of the *Y*-Chromosome in *Drosophila melanogaster*

THE general aim of this line of research is to detect hereditary substances in man and animals by means of immunological methods. We began with experiments on the *Y*-chromosome.

An intensely inbred stock of *Drosophila melanogaster* (Florida) was used. Rabbits were immunised, some by means of a gruel extract obtained from crushed male flies of this stock, and some by means of a similar extract obtained from the virgin females. Serum from the first group of rabbits was adsorbed

by means of a gruel obtained from crushed virgin females; serum from the second group was similarly adsorbed by males. In both sera the complement fixation reaction was made by using, as antigens, extracts of gruel of both males and females.

The results are presented in Table I:

TABLE I.*

| Material for immunisation | Material for adsorption | Results with ♂♂ antigen (number of experiments) | | | | | | Results with ♀♀ antigen (number of experiments) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ++++ | +++ | ++ | + | ± | − | ++++ | +++ | ++ | + | ± | − |
| ♂♂ | ♀♀ | 15 | 34 | 3 | 0 | 0 | 0 | 0 | 1 | 13 | 12 | 8 | 18 |
| ♀♀ | ♂♂ | 0 | 7 | 11 | 12 | 4 | 8 | 2 | 7 | 10 | 11 | 4 | 8 |

* The number of plusses indicates the degree of positive result of the complement fixation reaction, that is, of the absence of hæmolysis.

As evident from this table, the results are not free from defects, chief of which seems to be insufficient adsorption. Apparently the individual characteristics of the rabbits are also of importance, particularly in view of a certain percentage of comparatively weak positive reactions in the series of experiments in which the immunisation was made by means of male extract and the adsorption by means of female gruel, the male extract being used as an antigen.

In view of the possibility that the positive results of this latter series might be considered as due to antibodies formed not against the *Y*-chromosome but against products specific for the male plasm, another series of experiments was undertaken. Serum, derived by immunisation by means of *Drosophila* male extract and adsorbed by means of females of the same stock was, in addition, adsorbed by means of females of the type *XXY* (double adsorption being necessary because the latter females, taken from another stock, evidently differed genotypically from the first line).

The results of this series of experiments are presented in Table II:

TABLE II.

| Material for immunisation | Material for adsorption | Results with antigen (number of experiments) | | | | | | Results with antigen (number of experiments) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ++++ | +++ | ++ | + | ± | − | ++++ | +++ | ++ | + | ± | − |
| ♂♂ | ♀♀ *XX* and ♀♀ *XXY* | 0 | 0 | 2 | 2 | 3 | 2 | 0 | 0 | 0 | 0 | 3 | 6 |

Further experiments are in progress. Details as to technique and a detailed report on the results will be communicated elsewhere.

S. G. LEVIT.
S. G. GINSBURG.
V. S. KALININ.
R. G. FEINBERG.

Department of Genetics and the Immuno-Biological Laboratory,
Maxim Gorky Medico-Genetical Research Institute,
Moscow. May 28.

## Projection Method for Demonstration of Chromosomes *in situ*

THE demonstration of chromosome preparations has suffered from two serious difficulties in the past. First, the solid form of the object has to be reconstructed from images at different focuses, and it is impossible to be sure that an inexperienced observer has been able to do this. Secondly, chromosome behaviour in general has to be reconstructed from the observation of a great many cells, and their separate demonstration to one student, let alone a large number, is out of the question.

In order to overcome these difficulties (for the summer course of this Institution) we have experimented with the projection of images of the chromosomes on a screen, such as is commonly used for lower magnifications. We find that with a 10 ampère arc lamp, a strong condenser, and a water-ammonia heat-absorbing tank, a sufficient beam of light can be passed through the horizontal microscope (with a ×90 oil immersion apochromatic objective, N.A. 1·3, and a ×5 compensating eyepiece) to give a bright image magnified 5,000 diameters on a screen four feet in diameter and at a distance from the microscope of nine feet. The beam of light between the condensor and the microscope is enclosed to prevent glare. We find that a plain white screen is more satisfactory for our purposes than ground glass, opal glass, silvered or beaded screens. The microscope can be turned on a swivel, and the demonstration interrupted to show ordinary lantern slides.

This apparatus gives equally satisfactory results with well-differentiated hæmatoxylin and gentian-violet staining, with sections of root-tips and with smears of testes and pollen mother-cells. The form and internal structure of the chromosomes—their coiling and chiasmata—and the positions of such bodies as chromomeres and centromeres, 2000 A. in diameter, can be shown throughout the nucleus at focuses varying in depth 20–30 μ. They can be seen by ten or fifteen persons at once with our present experimental apparatus.

The use of this method should enable students to understand chromosomes in a real, and not merely a verbal sense. The apparatus can be made from everyday laboratory equipment and could, we believe, be installed with advantage wherever this subject is taught.

C. D. DARLINGTON.
H. C. OSTERSTOCK.

John Innes Horticultural Institution,
London, S.W.19.
June 30.

## An Early Magdalenian 'Raclette' Industry in the Lower Thames Valley

IN 1930, Dr. A. Cheynier described a newly-discovered industry of Early Magdalenian age, located at Badegoule in the valley of the Vézère, characterised by a large number of end- and side-scrapers made on flakes and showing vertical edge-trimming. He termed these specimens "raclettes"[1]. Mr. A. S. Barnes, who has made a special study of the Upper Palæolithic phases of the Dordogne, refers to this culture in a paper on the Magdalenian period

of France, in which he records the close similarity between the edge-trimming on these 'raclettes' and on eoliths[2].

I have lately found, in Stone Court Valley, a 'floor' on the surface of the Lower Flood Plain gravel situated at the base of the Sunk Channel and overlain by an accumulation of alluvial beds and hill-wash. The Sunk Channel was cut in Late Pleistocene times through the gravels of the Upper Flood Plain, which are here overlain by some 10 feet of glacial material. The Stone Court Valley industry is similar to that described by Dr. Cheynier and consists of quantities of 'raclettes', a few carinated scrapers, points with a small notch on each side of the butt (lames à étranglement basilaire), hand-adzes, cores and plain flakes.

Mr. Barnes had already remarked that the retouches upon the Badegoule 'raclettes' recall on a small scale the high-angle chipping on eoliths; but one of the most interesting features of the Stone Court Valley find is the recrudescence among the other artefacts of specimens analogous, both in sizes and forms, to the Harrisonian eoliths of the Kent Plateau.

The results of this investigation, which I am conducting through the generosity of the trustees of the Percy Sladen Memorial Fund and the kind permission of the management of the Associated Portland Cement Manufacturers, will be published in detail upon its completion.

J. P. T. BURCHELL.

30 Southwick Street,
W.2.

[1] *Bull. Soc. Préhist. Française*, **27**, 483 (1930).
[2] *Proc. Prehist. Soc. E. Anglia*, **6**, pt. 4, 316.

## Scientific Workers and War

THE article on "War, Science and Citizenship" in NATURE of May 9, and the letter on "Scientific Workers and War" published in the following week have expressed views no doubt widely held among readers of NATURE. Neither, however, gives any adequate suggestion as to how those scientific workers who hold such views can make them effective. Any steps depending on collective action through existing scientific organizations are obviously impracticable at the moment, for on the question of war, as on any other question of public policy, there are as wide differences of opinion among scientists as among the rest of the population. No existing organization of scientists, therefore, could at present make any pronouncement, apart from a purely platitudinous one, without serious loss of membership and of effectiveness in other directions.

On the other hand, an individual scientific worker who "first considers what ought to be done and then uses his influence to see that it is done" is acting simply as a private citizen and can do little to achieve that common action of scientists which is desired.

It seems to us, therefore, that the first requisite for any effective action along the lines indicated is the existence of an *ad hoc* organization of those scientific workers whose outlooks are sufficiently akin for an effective common policy to be possible. A policy arrived at by such an organization would not profess to be that of all scientific workers, but would doubtless carry great weight both among their colleagues and among many of the general public who are looking for a new lead. Furthermore, it might well result in existing scientific organizations, with their wider basis of membership, taking some kind of action. At the very least, it would call for a new standard of discussion among those who would oppose it.

A further difficulty must be faced. "To ally ourselves boldly with constructive political forces" as suggested, is not without its dangers. Opinions differ as to which political forces are the constructive ones. On matters where feelings run so high, any decisive action or expression of opinion is bound to cause offence in some quarters, and the offence is bound to be the greater the more original or effective such actions or opinions may be. Owing to their highly specialized training, many scientific workers have even more to fear than most people from the hostility of those who control their means of earning a livelihood. In these very questions to which we believe, with you, that professional scientists can make a distinctive contribution of real value to the community, we believe also that many of them—even in the remaining democratic countries—are kept silent by the certainty that an open expression of their opinions would seriously affect their careers or even bring them to a sudden end. This would certainly apply, for example, in many places to those holding some of the views mentioned in the Cambridge letter. It is with such considerations in mind that there has arisen among the staff and research workers of this University a group whose aim is to investigate the root causes of war and to find means of avoiding it. Isolated groups are, however, of little greater effect than isolated individuals, and we should welcome contacts with similar groups elsewhere in the hope of being able to arrive at a common programme.

E. BARROW, M.B.
J. DONEN, PH.D.
C. A. DU TOIT, PH.D.
B. GERSHILE, B.SC.
W. F. GRANT, B.SC.
W. S. S. LADELL, B.A.
L. A. J. LINCOLN, B.SC.
C. B. O. MOHR, PH.D.
C. J. MOLTENO, B.A.
E. O. PABST, M.SC.
G. F. PAPENFUSS, PH.D.
G. SACHS, M.B., F.R.C.S.
H. SANDON, PH.D.
N. SAPEIKA, B.A., M.B., CH.B.
J. G. TAYLOR, M.A.
E. M. THOMPSON, B.A.
J. WRIGHT, B.A., B.M., B.CH.
H. ZWARENSTEIN, PH.D.

University of Cape Town.
June 15.

## Photo-Reduction of Fluorescent Substances by Ferrous Ions

DR. K. WEBER[1] has recently published a note on experiments which he connects with the results published previously by me[2]. There is, however, not much relation between his experiments and my investigations, as may be clear from the following remarks. Dr. Weber seems to be unaware of the fact that by the method which I described it is only possible to reduce fluorescent substances, and then only when they are in a suitable state to exhibit fluorescence. Indeed, his own failure to reduce dyestuffs such as neutral red and Nile blue, which he has reported recently[3], can be attributed mainly to the fact that these dyestuffs are non-fluorescent in aqueous solution.

It has been shown previously that, in principle, every fluorescent substance can be reduced by the influence of light in the presence of suitable reducing substances, for example, $Fe^{++}$ ions, $SO_3^{--}$ ions[4], $HS^-$ ions[5], reversibly or irreversibly. Dyestuffs

can always be easily reduced when they are fluorescent in aqueous solution, and Dr. Weber did not fail to confirm this. The reason simply is that the photo-reduction is identical with the elementary process of quenching of fluorescence. The dyestuff molecule in the excited state ($F^*$) which possesses an unoccupied electronic level (due to the excitation of one electron to a higher level) can take up an electron from a reducing (quenching) substance (into this level) according to the process :

$$F^* + Fe^{++} \rightarrow F^- + Fe^{+++}; \quad F^- + H^+ \rightarrow FH \text{ (reduced dyestuff).}$$

In this way the excitation energy in effect increases the electron affinity of the dyestuff molecule ($F$). When there is no fluorescence, there are no excited dyestuff molecules of an appreciable life-time, and consequently no photo-reduction can take place.

The photo-reduction is not quite so simple in the case of chlorophyll and other fluorescent substances which give non-fluorescent aqueous solutions, and where it is necessary to use a suitable mixture of solvents (for example, aqueous methyl alcohol), in which the ferrous salt is sufficiently soluble and also the dyestuff (chlorophyll) is capable of fluorescence.

Further details are given in a paper[6] which has recently appeared, and an additional paper on the same subject will be published shortly.

JOSEPH WEISS.
Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College,
London, W.C.1.

[1] K. Weber, NATURE, 137, 870 (1936).
[2] J. Weiss, NATURE, 136, 794 (1935).
[3] K. Weber, *Naturwiss.*, 23, 486 (1935).
[4] J. Weiss and H. Fishgold, NATURE, 137, 71 (1936).
[5] J. Weiss, *Naturwiss.*, 23, 610 (1935).
[6] J. Weiss and H. Fishgold, *Z. phys. Chem.*, B, 32, 135 (1936).

## The Mysterious Number 137

THIS is stated in NATURE of May 23, p. 877, to be more accurately 137·2. Now 1371288 is the natural number similar to the mantissa of its logarithm. How will this fact interact with the formulæ of origin ?

FLINDERS PETRIE.
American School of Research,
Jerusalem.
June 1.

## Points from Foregoing Letters

To explain the elastic properties of viscid fluid threads, Sir Joseph Larmor imagines their molecules to be shaped like dumb-bells, interacting by forces between their ends, so that when two rows lie in parallel there is a position of equilibrium when the ends are opposite each other, and an elastic reaction comes into play which allows of a large range of reversible extension.

Crystalline pepsin is inactivated at a rate inversely proportional to the fifth power of the hydrogen ion concentration, between $p$H 6·2 and 6·45. This behaviour, Dr. J. Steinhardt considers, suggests the presence of an unstable pepsin ion, formed by the dissociation of five acidic groups with dissociation constants near $1{\cdot}7 \times 10^{-7}$.

From the reaction shown by regenerated tails of tadpoles and pieces of *Euplanaria* with sodium nitroprusside, N. S. R. Maloeuf concludes that the nitroprusside colour test is specific for the oxido-reduction enzyme glutathione, when applied to normal living tissues and when ammonium hydroxide is used as the alkali. Heat must not be applied, since it liberates free $-SH$ radicals from protein, which then give a colour with the nitroprusside and invalidate the test both for glutathione and cystein.

F. Bergel and A. R. Todd discuss the possible structural formulæ of aneurin (vitamin $B_1$) and its oxidation product, thiochrome. Certain synthetic compounds show a fluorescence similar to that of thiochrome, and their known structure supports the formula suggested by Makino and Imai, and modified by Williams.

The formation of a radioactive isotope of iron by irradiation of cobalt with neutrons is reported by Prof. E. B. Andersen. The new isotope is probably iron of mass 59, and shows an activity decaying with a period of nearly 72 hours.

Dr. H. S. W. Massey and R. A. Buckingham calculate the values of the van der Waals' interatomic constant from observations by Rosin and Rabi on the collision of rare gas atoms (helium, neon and argon) with alkali atoms, observed by the molecular ray method. The authors compare the values with those derived from the polarizabilities of the atoms, and conclude that the free path method will prove convenient for the determination of van der Waals' forces.

An investigation by A. R. Hogg of bursts of cosmic radiation of estimated size 35–1800 rays suggests that the rays responsible for producing these bursts occur relatively infrequently, but that each ray has a fairly high probability of producing a burst. This probability varies with the barometric pressure.

Instances are quoted by B. R. Speicher to show that hybrid queen bees produce equal numbers of impaternate drones with dominant and with recessive characters. Hence he concludes that the impaternate drones in bees and wasps (sub-order Apocrita) are 'haploid', that is, they have the basic number of chromosome number in their nuclei, and are not 'diploid' as recently suggested in the case of male impaternate saw-flies (sub-order Symphyta).

The formation, in rabbits' serum, of 'antibodies' specific for the $Y$-chromosome of the male fruit-fly, after injection of a gruel of the insects, is indicated by experiments carried out by Dr. S. G. Levit, S. G. Ginsburg, V. S. Kalinin and R. G. Feinberg. An antibody when formed in the serum of living animals after the injection of an 'antigen' (in this case, extract of fruit-flies) 'fixes' the 'complement', a ferment which, in conjunction with an 'amboceptor', hinders the break-up of red blood cells and of bacteria.

A simple arrangement for the direct projection on a screen of microscopic slides showing the internal structure of chromosomes is described by Dr. C. D. Darlington and H. C. Osterstock.

J. P. T. Burchell reports the finding, in Stone Court Valley, of a 'floor' containing stone implements, including 'raclettes', at the base of the Sunk Channel, cut in Late Pleistocene times. The artefacts show features analogous to those observed among the 'eoliths' (earliest stone implements of tertiary age).

# Research Items

## Antiquities of the Jumna Valley

AN investigation by Prof. B. Sahni of mounds on the outskirts of the city of Khokra Kot, where their structure has been revealed by ravines cut through by rains, has produced a large number of relics, old bricks, pottery, etc. (*Current Science*, May 1936). A well-defined dark layer exposed in the side of a cliff at three feet below the surface, yielded hundreds of black terra-cotta disks, afterwards identified as moulds for coins. These, as is shown by a Brahmi inscription, must be assigned to the Yaudhiyas and dated at about 100 B.C. Some were found afterwards still to contain coins. The coins are of bronze. On the obverse is a humped bull, looking to the right, with head obliquely pointing to the observer. In front of it is the conventional sign for a tree enclosed within a railing. On the reverse is an elephant, also pointing to the right, in various postures of walking or running, with trunk upraised. In some, the tail is bifurcated. Above is the Brahmi letter *ga* and the *triratna* or *nandipada* symbol. The matrices were either baked over a slow fire of paddy or wheat and barley, or they were packed in them, when the molten metal was poured in. They show impressions of the paddy straw, and charred grains adhere to them in the form of a carbonized crust. A terra-cotta model of a humped bull probably came from the same level. Other relics belong to a distinctly lower, and probably earlier, level. A glazed pot of white paste bears on its inside a clear impression of a finely woven cloth. In this was an ink-like substance, which analysis has shown to consist of carbon (lamp-black) with mineral substances. A shell bead is carved out of the columella of a large gastropod. It is suggested on the ground of the resemblances of these objects in style to antiquities from Mohenjo-daro and Harappa, that there may be in the Jumna valley a tradition of a connexion with the Indus valley civilization, which systematic investigation on this site might confirm.

## Antithyrotropic Activity

THE injection of extracts of anterior pituitary causes hyperplasia of the epithelium of the thyroid gland and general symptoms of hyperthyroidism. The effect on the thyroid is not maintained for long, and the symptoms of hyperthyroidism disappear, in spite of the continuance of the injections. Collip and Anderson showed that this disappearance of the effects is due to the appearance of inhibitory antithyrotropic substances in the blood. Rowlands and Parkes (*Proc. Roy. Soc.*, B, **120**, 114; 1936) have studied the properties of this antihormone. Inhibition of the effect of thyrotropic extract on the weight of the thyroid of the immature guinea pig was used as a test of antithyrotropic activity, and a method of assay is described. Normal blood has no action. If thyrotropic extract is injected daily into rabbits, antithyrotropic activity begins to appear after four weeks and reaches a maximum in ten weeks. The results described are in complete agreement with the antihormone theory of Collip and his co-workers. It would be difficult to over-estimate the biological importance of this theory.

## Northern Phytoplankton and its Production

DR. E. STUMANN NIELSEN has investigated the general plankton production conditions in the Faroe, Icelandic and East Greenlandic waters proper as well as dealing, although in less detail, with the whole of the northern region of the Gulf Stream and the bordering colder regions (*Meddelelser fra Kommissionen for Danmarks Fiskeri og Havundersøgelser.* Serie: Plankton. **3**, No. 1; 1935). He gives the results during 1932–34, made chiefly with the Danish research ship *Dana*. All the plankton work was done in close co-operation with the hydrographic observations, and in 1934 the transparency of the water was also registered. The phytoplankton production is one of the most important links in the chain of factors leading to the production of great fish populations. On it depend the fisheries of all our seas either directly or indirectly. The conditions of production are of a very diverse character in the different seas around Iceland and the Faroe Islands, the factors that are of importance do not act in the same way everywhere, and it is only when they act together as a harmonious whole that the possibilities of production are optimal. Light and the quantity of nutritive salts are of supreme importance in restricting the plankton production in northern waters, but there depend many other factors which partly work into one another, such as stabilisation of the surface layers and the transparency of the water (including amount of detritus present); temperature and salinity having as a rule only a regulating effect. More exact studies into vertical movements of the volumes of water in the sea are advocated and also systematic investigation regarding the transparency of the sea throughout the year, together with detailed inquiries into the relation between the areas with large production of phytoplankton and those with great fish populations.

## Researches on the Sucking Lice

THERE has recently come to hand Part 8 of "Contributions towards a Monograph of the Sucking Lice" by Dr. G. F. Ferris, and published by the Stanford University Press, California. This fascicle forms No. 8 of vol. 2, Stanford University Publications, Biological Series, 1935, and completes the monograph concerned. It deals especially with the lice of man and certain other primates. The author arrives at the conclusion that the genus *Pediculus* contains but three species. The question, so often debated, as to what constitutes a species is of particular interest in connexion with this genus, and the author defines his attitude as regards the problem as definitely as possible. Of the three species recognized, ***P. humanus*** L. is adopted as the name for the whole assemblage of Pediculi found on the races of man. It seems clear that it can also establish itself upon other primates which have been in contact with man. The validity of the author's conclusions remains to be tested by experimental work upon the various forms that are known to occur. The second species, ***P. mjöbergi*** Ferris, infests monkeys of the family Cebidæ, and ***P. schäffi*** Fahrenholz occurs on the chimpanzee. Of the genus ***Phthirus***, in addition to ***P. pubis*** (L.), the existence of a second species, ***P. gorillæ*** Ewing,

is doubtful, and adults are, as yet, undescribed. The fascicle concludes with an appendix relating to Anoplura dealt with in the earlier parts of the monograph, and an index.

### Inhibitors of Tobacco Mosaic Virus

SEVERAL viruses produce local lesions upon the inoculated leaves of certain host plants, and this capacity has been used to test the effects of various inhibiting substances. It has not, however, always been possible to determine whether the inhibitor was acting upon the virus or the host, but Dr. J. Caldwell has evolved an interesting technique to separate these effects ("Factors affecting the Formation of Local Lesions by Tobacco Mosaic Virus", *Proc. Roy. Soc.*, B, **119**, 493–507, March 1936). The earlier part of the paper shows that if the inhibitor acts upon the virus, its effect should increase with decreasing virus concentration, and the reverse effect would indicate inhibitory action upon the host. Experiments with normal sera of horse and rabbit, with trypsin, and with silver nitrate, indicate that all these inhibitors act upon the virus. The mode of action is not yet quite clear, but should form a fascinating subject for future study.

### Unity of Force and Matter

THE Masaryk Academy of Work has just published a thesis by Dr. J. Bašta entitled, "L'unité de la force et l'unité de la matière dans la conception physique uniforme du monde", in which the author sets out to show that, mathematically and physically, all matter is composed of what he terms 'proto-atoms'. Experiments are cited to indicate the possibility of reducing the various causes of pressure and acceleration, for example, cohesion, adhesion, chemical affinity, adsorption, vapour pressure, osmotic pressure, gravity, magnetic and electrical attraction and repulsion, etc., to a single force. This force is the cause of strain in static states and of acceleration under dynamic conditions. It is supposed that this simple force is the attraction of the smallest elementary particles of matter (proto-atoms). The range of action of these bodies is limited by the amplitude of their vibrations. The attraction is transmitted only by contact of one particle with its neighbour. All action at a distance is excluded. The primary sources of this elementary attraction are the proto-atoms. Atoms of the chemical elements and also the ultimate particles of cosmic ether represent different complexes of these ultimately simple proto-atoms which, it is postulated, are only able to exercise an influence on primary matter in their own material system or on other systems by their residual lines of force.

### Oceanography and Meteorology of China Seas

*Koninklijk Nederlandsch Meteorologisch Instituut* publication No. 115, entitled "Oceanographic and Meteorological Observations in the China Seas and in the Western part of the North Pacific Ocean", is a large atlas in which are set out cartographically the extensive observations collected during many years by Dutch and other ships in East Asiatic waters in a similar form to that of the atlases of the Indian Ocean (Publication No. 104) and of the Atlantic Ocean (No. 110). The text is in Dutch, with an English translation, but the names on the maps are in English only. The work is in accordance with the recommendations of the Fourth Pacific Science Congress of 1929 at Batavia for active international co-operation to develop the practical and scientific aspects of oceanography and meteorology, and for this reason more observations from ships of other nationalities—especially those of Great Britain, the United States, France and Germany—have been used than in the case of the similar earlier Dutch publications. The result is an impressive mass of marine statistics set out in great detail and with admirable clearness, on charts roughly 18 in. × 18 in. It is a bulky publication, which when open occupies a space of 3 feet 6 inches by nearly 2 feet, but by adopting a large size for the charts excessively small lettering has been avoided. For the General Current Circulation 'one degree squares' are used. Each of these contains an arrow showing the average observed resultant current, and figures alongside giving the average speed in nautical miles per day and the number of observations, while the stability of the circulation is shown by the length and thickness of the arrow. Each month is dealt with separately; the information just described is shown on the left hand page at an opening, while on the right hand page the current roses for the same month are given on 'squares' of rather larger size—generally 5° of longitude by 3° of latitude. These roses follow a well-known standard form, the percentage frequency of a given direction of current being shown by a suitable length of line on the scale 1 mm. = 2 per cent, and various ranges of speed are represented by various thicknesses and shadings of line. On the same system of 'squares' the monthly data for the ordinary meteorological elements, wind, fog, precipitation, pressure, air and sea surface temperature are set out, and also the tracks of the more important temperate depressions (here designated continental depressions) and typhoons.

### Iron Wire and Nerves

IN the study of complex problems, the construction of a simplified model may serve as an aid to comprehension. It is now eighteen years since R. S. Lillie first directed attention to the similarity between the properties of iron wire immersed in nitric acid and those of living nerves. During these years the phenomenon has been more closely studied, and many more points of similarity have been discovered. A review of the present situation has recently been published (*Biol. Rev.*, **11**, 181; 1936). When the iron wire is placed in nitric acid it is quickly covered with a film of oxide which protects it and makes it 'passive'. If this film is broken, the damaged area becomes anodal and local currents flow which break down a new area of the film, and this in turn 'stimulates' another area and an 'impulse' passes along the wire. When the impulse has passed, the damage is quickly repaired. The model resembles nerve in the fact that it can be stimulated by electric currents, and the laws governing the conditions necessary for excitation are similar. The 'chronaxie' of a certain model was about the same as that of heart muscle. After stimulation, the model shows an absolute refractory period followed by a relative refractory period. The temperature coefficients of the two processes are about the same. If the wire is enclosed in a tube the velocity of transmission is diminished. This is compared with the slow transmission in small nerve fibres. If a wire is enclosed in a series of short tubes, the impulse can jump straight from one node to the next and the impulse passes quicker than normally. This is compared with the nodes on the myelin sheath of certain quickly-conducting nerves. Under certain conditions, models may show rhythmical activity.

# Centenary Celebrations of the University of London

THE hundredth anniversary of the University of London was celebrated during the week June 29–July 3 with a full programme of functions. The proceedings were inaugurated at an afternoon reception on Monday, June 29, in the Great Hall of the University at South Kensington. Here nearly two hundred representatives of universities and learned societies in every corner of the globe assembled to present addresses of congratulation and goodwill. The Chancellor, Lord Athlone, in welcoming the delegates, said that this great convention was a healthy reminder that learning recognized no national frontiers, that the whole band of great teachers, the whole band of eager students, were truly citizens of the wide world, and their influence for good was incalculable and illimitable. Honorary degrees were conferred on the following distinguished men, who were presented by the Public Orator: The Archbishop of Westminster, Dr. J. W. Mackail, Sir Charles Peers, Prof. G. M. Trevelyan, Mr. H. G. Wells, Senor Don Ramon Perez de Ayala (Doctors of Literature); Mr. S. A. Courtauld, Mr. P. M. Evans, Sir Joseph Larmor, Sir George Newman, Lord Snell, Lord Wright (Doctors of Law); Dr. R. Vaughan Williams (Doctor of Music); and Sir William Bragg and Prof. Max Planck (Doctors of Science). Degrees were also conferred *in absentia* on Dr. Emile Legouis (Doctor of Literature); Mr. Justice Cardozo (Doctor of Laws); Prof. Albert Einstein and Prof. Johan Hjort (Doctors of Science).

In the evening of the same day, a dinner was held at Grosvenor House. The Chancellor, who presided, read a message from His Majesty the King, Visitor of the University, conveying his sincere congratulations to the University on the occasion of its centenary, and alluding to the progress of the new buildings at Bloomsbury as marking the beginning of a new era as well as a new century in the life of the University. Sir Thomas Inskip, in proposing the toast of "The University", said that within the space of a hundred years the University had attained such a position that it was able in everything but antiquity and beauty of situation to challenge the supremacy of the two great Universities of Oxford and Cambridge, and had fully justified the foresight of those who founded it. Time would make it as venerable as its rivals, and the generosity of public and private benefactors would soon enable the University to have buildings as beautiful and as well placed as any in the land.

The Chancellor, in reply, commented on the happy spirit of co-operation and goodwill which to-day existed between the learned institutions of the world. The exchange of teachers and students and ideas was of the utmost significance, and the Universities of the world might well claim that they were making a contribution of high value and importance in the promotion of peace and understanding. He stressed also the importance of unity, though not necessarily uniformity, within the University itself, and remarked on the analogy which the constitution of the University, with its federation of semi-autonomous Schools, presented to the British Empire. The one was no less real than the other. "The respective spheres of University and College", he said, "are clearly defined in black and white but no written statute is of any avail apart from that spirit of goodwill, that desire to pull together, which is characteristic of London University". The toast of "The Guests" was proposed by the Vice-Chancellor, Mr. H. L. Eason, who said: "This great gathering is a token that the ideal that should underlie all Universities is not forgotten, namely, that academic learning should have no boundaries of space, nationality, religion or politics. Without this spirit, learning would have perished in the Middle Ages, and there never was a period in the world's history when the maintenance of complete academic freedom of thought was more urgently needed than to-day". Prof. Louis Cazamian, of the University of Paris, Mr. G. H. Wilson, vice-chancellor of the University of Cambridge, Prof. L. P. Eisenhart, of Princeton University and Sir James Barrett, Chancellor of the University of Melbourne, responded, and congratulated the University on the distinguished record of its first hundred years.

Tuesday, June 30, was devoted mainly to functions at the various Colleges, while in the evening the Worshipful Company of Drapers, old and generous friends of the University, gave a ball at the Drapers' Hall.

On Wednesday, July 1, the University's friendly relations with the City of London were once more demonstrated and reaffirmed. To the special service of thanksgiving at St. Paul's Cathedral came a vast congregation of members and friends of the University. The citizens of London gazed upon a striking and colourful scene as the processions in academic costume wound up Ludgate Hill. First the professors and readers entered the Cathedral. Then came the Lord Mayor, the Sheriffs and Corporation; and finally the Chancellor's procession, consisting of the delegates from sister universities and learned bodies, honorary graduates, the Court and Senate and the Chancellor. The service, which was broadcast, was impressive in its simplicity. The Archbishop of Canterbury, in an eloquent sermon, paid tribute to the high ideal which had animated the founders of the University one hundred years ago and which was still incorporated in the Statutes, "to hold forth to all classes and denominations without any distinction whatsoever an encouragement for pursuing a regular and liberal course of education". This ideal was now accepted as a commonplace of public policy, but in those days great courage was needed to assert it. The University had been a pioneer of the movement which had given universities to most of our large cities, and though unlike its younger sisters it had not been able, by reason of the vastness of London, to make such an impact on the life of the city, the presence of an institution which not only prepared students for profitable and useful careers but which also fostered the things of the mind and the spirit, the pursuit of knowledge and truth for their own sake, was of incalculable benefit to London. Throughout its development the University had lacked one thing—a body, so to speak, in which its soul might find a fitting home. This was now at last to be remedied, and at Bloomsbury there was arising a great building wherein for the first time the length

and breadth and depth and height of the ideals for which the University stood would find a visible, noble, enduring embodiment and witness—a reminder to London that it had its own University in its midst.

After the service, the Lord Mayor and Corporation gave a luncheon in Guildhall. Lord Halifax, speaking as Chancellor of the University of Oxford, said that one of the greatest achievements of the nineteenth century was the assertion of the principle of an extended university education. This had inevitably given rise to a tendency to consider that the progress of the human race was automatic, provided that education could be sufficiently widely diffused. It was, however, being increasingly realized in these days that much knowledge might be a dangerous and destructive thing unless it was directed by something greater than itself. One had only to think of man's discovery of aeroplanes, of chemical laws and products and even of the internal combustion engine, to realize how dangerous they could be, unless guided and inspired by that which was greater than themselves—wisdom. Civilization must depend on training men to become masters rather than victims of their own inventions. No greater aim could be set before a university, and they could wish no better thing for London's university than that for the next critical century of its history it might continue to inculcate those principles to which in the past hundred years it had been so faithful.

The Chancellor, in reply, said that the first and perhaps the most difficult stage of the University's history was now past, and they might recall, with justifiable elation, the apprehension and dismay with which at the outset the project was greeted. All that the University had striven and was striving for would be consolidated in its new home, and there the University would pursue its course, going quietly and steadily forward; and when the next hundred years had passed there would be found the same spirit, the same high ideals, which animated the University of London to-day.

Lord Macmillan, chairman of the University Court, who proposed the toast of "The Lord Mayor and Corporation", referred to the friendly relationship between 'town and gown' which had always existed in London, and recalled episodes separated in time by more than a hundred years in which the City Corporation had shown its great interest in the cause of university education in London. The University, like the City, was engaged in commerce —not of commodities but of ideas—a commerce which knew no quotas, no embargoes, but where universal free trade existed. The best means for bringing about in the distraught world a renewal of friendship, mutual confidence and well-being, was by the promotion of those common bonds which scholarship and learning alone could furnish. The Lord Mayor, responding, said that the Corporation of London had always identified itself with the cause of education and had ever striven for that freedom of thought and action, in the wise and appreciative use of which the finest achievements of the human mind had become available for the benefit of mankind.

In the evening, His Majesty's Government held a reception at Lancaster House, where the guests were received by the Lord President of the Council and Miss MacDonald.

The proceedings were brought to a conclusion on Friday, July 3, with a brilliant reception given by the London County Council, the hospitality of which once more bore witness to the generosity and goodwill which characterizes its relationship with the University.

Throughout the week, hospitality was freely extended to the delegates by the Colleges and Schools of the University in the form of luncheons, garden parties, dinners and evening receptions, and all offered facilities for the visitors to see something of their work and activities.

A memorable occasion was thus worthily celebrated. The University, on the threshold of a new phase of its existence, may well be satisfied with the demonstrations of loyalty and friendship which the completion of its first hundred years has evoked, not only from those within its bounds but also from all those far and near who come into contact with its widespread activities.

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# The National Physical Laboratory

## ANNUAL INSPECTION

ON July 1, the annual inspection of the work in progress at the National Physical Laboratory was made by the General Board and also by a large number of visitors representative of scientific, academic and commercial institutions throughout the country. The visitors were received in the High Voltage Laboratory by Sir William Bragg, president of the Royal Society and chairman of the Board, the Right Hon. Lord Rayleigh, chairman of the Executive Committee, and Sir Frank Smith, director of the Laboratory. Some three hundred exhibits illustrating the work performed in the eight departments of the Laboratory were on view; a brief summary of some of the more recent or interesting developments is given below.

In the Physics Department, the analogous problems of the transfer of heat from metal pipes and moisture from wet surfaces to a stream of air flowing over them have been investigated, and similar laws are found to hold for the two processes. The effect of inducing turbulence in the air-stream has also been studied. A simple falling plug method for determining the viscosities of liquid refrigerants has been devised. The apparatus is calibrated with liquids of known viscosity, and may easily be adapted to work under pressure and at low temperatures. The investigation of the changes of length of hygroscopic materials with humidity has continued and a demonstration was given of the application of such a material—gold beaters' skin—to the maintenance

of constant humidity in a chamber. The thermal conductivity of a variety of materials used in building and refrigerating practice has been measured with the cold face at normal or low temperature. The thermal conductivity of metals at high temperatures is obtained by connecting the specimen in series with a rod of iron of known conductivity and measuring the temperature gradient through the latter.

Work on the application of X-ray methods to industrial problems has continued in the Radiology Division with the object of correlating the physical, electrical and magnetic properties of materials with their lattice structure. In this connexion, the effect of fatigue stresses on the structure of mild steel specimens has received a considerable amount of attention recently. For the checking of 'air-wall' ionization chambers designed to measure radium dosage in röntgen units, a 'free-air' ionization chamber approximately 10 ft. square in cross-section has been constructed and was exhibited. The experiments with this have shown that the results obtained with an 'air-wall' ionization chamber of suitable wall thickness are quite trustworthy. A single-stage electrometer-valve amplifier has been used for the rapid measurement of radium by the $\gamma$-ray method. The results obtained with it agree satisfactorily with those given by the standard apparatus.

A considerable amount of test work on sound-absorbing and other building materials has been carried out in the Acoustics Laboratory, and routine testing of the transmission of sound through walls and floors was demonstrated. The methods for the calibration of microphones in absolute measure have recently been extended, and standard instruments were shown, the calibration of which was known over the whole frequency range from 10 to 10,000 cycles per second. The standardizing apparatus and lagged chamber with which these calibrations were obtained were also on view.

In the accurate calibration of thermocouples it is necessary to maintain the furnace at a constant temperature for relatively long periods. A high degree of thermostatic control has been obtained by making the platinum heating element one arm of a Wheatstone's bridge which is arranged to be balanced at any desired resistance—and hence temperature—of this element. In this way it has been found possible to control the temperature at any point in a furnace to 0·01° C. at temperatures in the region of 1,000° C. A very close approach to a true black-body radiator has been realized by introducing a hollow nickel cylinder into a tubular furnace thermostatically controlled as above, and compensating for the axial temperature gradient in the nickel by additional heating elements at its ends.

In modern optical instruments, considerable attention has been paid to the attainment of greater light efficiency, and field brightness tests have assumed greater importance than hitherto. Photo-electric methods have now replaced the ocular methods previously used, and greater precision and rapidity in carrying out these tests have resulted.

The high precision obtained in frequency measurement in the Electrical Standards Division of the Electricity Department by the use of quartz ring and tuning fork oscillators has now been utilized so that the whole of the audio frequency range may be covered in small steps by frequencies which are known to within a few parts in $10^6$. An oscillator of multivibrator type is tuned approximately to the frequency required, which must be a submultiple of 1,000, 20,000, 40,000 or 80,000, and is then held in step by an output of one of the above frequencies obtained from the primary standard. In this Division also the use of platinum as a material suitable for standard resistance coils has been investigated. The high temperature coefficient of this material necessitates a very accurate control of the temperature at which the coils are measured, but nevertheless with suitable precautions it has been found that results consistent to about 1 part in a million may be obtained. A very useful method of measuring dielectric properties at very high frequencies has recently been developed. It depends essentially upon the measurement of the width of the resonance curve of a tuned circuit which contains the specimen under test. Measurements over the frequency range $10^4$–$10^8$ cycles per second have been made by this method.

The stroboscope method of frequency control in the Electrotechnics Division has been materially improved during the past year by the elimination of contacts on the standard tuning fork. A valve-maintained fork is now used, the output coil of which is connected to the grid of a thyratron. By this means a charged condenser is made to discharge through the thyratron and the primary of an induction coil once per fork cycle. Special neon lamps connected in the secondary circuit of the induction coil illuminate the stroboscope disc.

In the High Voltage Laboratory researches on the effect of transient voltages on insulation in general are proceeding, and the technique of high-speed cathode ray oscillography has been further improved. The testing of a lightning arrester connected across the end of the new overhead transmission line was demonstrated.

During the past year a new Photometry Building has been erected to accommodate the photometric work and the illumination research of the Electricity Department. In the design and equipment of the building special attention has been paid to the particular requirements of this work. In addition to rooms for routine photometry, preparation and maintenance of substandards, and experimental research, the building contains a wide room 145 feet long for work on all types of projection apparatus. By opening a roller shutter at one end of this room, the range over which this work is carried out can be extended when necessary to nearly 800 feet. Various problems in connexion with glare and its after-effects are being examined in the Division. To enable the results to be applied in practice, a knowledge is required of the rate of expansion of the natural eye-pupil during recovery from exposure to a high brightness. The subject is most conveniently studied by taking a cinematograph film of the eye during recovery, using for this purpose infra-red radiation, which does not affect the phenomenon under investigation.

A photo-electric daylight factor meter has been developed in the Division. The instrument consists in essence of two rectifier photo-cells in circuit with a microammeter. One is placed on the window-sill and receives light from a definite small solid angle of the sky. The other, which is compensated for light obliquity, is placed at the point where the daylight factor is to be measured. There is a variable resistance in parallel with the photo-cell on the window-sill. The mode of operation is to adjust this resistance until the microammeter reading remains the same, when it is connected in succession to the

photo-cell resistance combination and to the photo-cell in the room. By means of a calibration curve, the daylight factor is given directly by the values of the resistance.

A photo-electric spectrophotometer, incorporating a thin film potassium photo-cell, has been designed for the rapid determination of the spectral transmission of coloured filters. A method has been devised for checking the linearity of the photo-cell characteristics at any desired wave-length.

In the Radio Department advantage has been taken of the fact that magnetron valves used for generating very short waves may, by the application of sufficiently intense magnetic fields, be made to operate at frequencies at which direct measurements of their input impedance are possible. In this way it has been found that electronic oscillations occur in such a valve near the condition of resonance. A portable direction-finding receiver for operation on wave-lengths between 8 metres and 10 metres was exhibited. The receiving loop is screened inside a solid copper tube and a push-pull input connexion to the first stage of the receiver is used to maintain electrical symmetry. A direct-reading frequency-measuring equipment has recently been constructed in this Department whereby the frequency of any radio oscillations between 1 and 70 megacycles may quickly be determined with an accuracy of 1 part in a million.

With the object of achieving greater stability in the frequency of transmitters, the work on design of condensers and inductances of low temperature coefficient of reactance has continued and a selection of such components was shown. An automatic monitoring system for the control of the frequency of a transmitter by a stabilized master-oscillator has been developed for use with the above. A novel exhibit in this Department was the outcome of co-operation with the Forest Products Research Laboratory. The apparatus was designed to detect the presence of destructive insects in timber, and consists of a sound-proof chest, a sensitive microphone and a high-gain amplifier. The microphone is placed in contact with the specimen of timber in the inner box of the chest, and any faint sounds created by destructive insect activity are received by the microphone and amplified to audible level.

Among the exhibits in the Metrology Department mention should be made of the interference apparatus for precise measurements of the refractive index of air. The method consists in the observation of Brewster's fringes in monochromatic light produced by two tubular invar étalons, one being permanently evacuated and the other containing dry air under the required conditions of test. The latter étalon is then evacuated, and from the change in the fringe system the value of $\mu$-1 may be calculated. Measurements on photographic records of the fringe patterns made with the aid of a microphotometer enable a precision of 0·01 of a fringe interval to be obtained.

The new type of comparator for block gauges is now completed, and offers increased facilities for measuring the larger sizes of gauges to an accuracy of a millionth of an inch. The new pitch measuring machine for tapered screw gauges has also been completed. In addition to these exhibits, a large variety of machines used in the routine testing of engineers' gauges of every description was shown. An automatic pipette for the delivery of small and accurately known quantities of mercury was demonstrated in the Glass Testing Building.

Research in the Engineering Department on the structural changes associated with static and fatigue fracture of metals has been continued throughout the year: the X-ray method of attacking this problem has proved very valuable, since the primary cause of failure is associated with changes of a sub-microscopic nature in the crystalline structure. In connexion with researches in this Department on the wind pressures around buildings, the experiments on isolated models have now been extended so as to determine the effect of neighbouring structures. In order to obtain results which may be applied to structures in built-up areas, a model of the buildings lying in an area about half a mile square immediately to the north of the Thames Embankment has been constructed. This can be accommodated in the 14-ft. wind tunnel, and the actual test model is placed near the middle of this built-up area. Other aerodynamical problems under investigation are the characteristics of air streams loaded with granular matter, and the effect of roughness of pipes on air flow through them.

Wheel impact measurements have been continued throughout the year on a six-wheeled lorry under various types of loading, tyres and road surfaces. The equipment for carrying out similar tests on a private car has just been completed, and an economy in size and power consumption of the recording apparatus has been achieved. Typical records obtained in the course of this investigation were exhibited.

In the section devoted to lubrication research, refined measurements have been made of the change of shape at the crown of the bush when a plain bearing is run to seizure. The beneficial effects of rotation in both directions during the running-in of a bearing have also been demonstrated. The influence of temperature and rate of oscillation on the friction developed in an oscillating bearing is also under investigation, and the characteristics of various oils, in particular the extreme pressure lubricants recently developed, have been studied with the aid of two new machines in which the bearing surfaces are well defined. An investigation into the behaviour of bolted pipe flanges under high-pressure high-temperature steam is being carried out with the view of obtaining leak-proof joints in pipes operating under these conditions.

Among the researches in progress in the Metallurgy Department, that dealing with the alloys of magnesium promises to have important commercial results on account of the lightness combined with strength of some of these alloys. The technique of working such alloys is also being developed. Work on alloy steels for use at high temperatures is being continued, and corrosion tests on specimens exposed to high-pressure steam have been carried out. A method of determining thermal curves at high temperatures *in vacuo* was demonstrated in the high-frequency furnace room. The accessory apparatus made and used in the routine work of this Department was exemplified by a comprehensive display of refractory materials, including articles of sintered alumina and thoria for use at very high temperatures. A potentiometer was also demonstrated by means of which thermal curves of metals and alloys can be plotted automatically on a chronograph. The potentiometer dials are operated by an electric motor which is controlled, through a relay and photo-electric cells, by the light reflected from the galvanometer mirror.

An interesting exhibit in the Aerodynamics Department was an instructional film produced in this Department to show the flow of air around various models. The flow is made visible by producing a succession of hot spots in the air stream by means of spark discharges and observing them by the *Schlieren* method of illumination. The transitory and steady state conditions following the initiation of the air stream were illustrated with several models. By using a high-speed camera, it is possible by this method to analyze changes in the motion which are far too rapid to be seen by the eye.

The high speeds at which modern aircraft now operate have called for aerodynamical surfaces and shapes which offer as little drag as possible. This is not always compatible with the attainment of the requisite mechanical strength in the part concerned—notably in the case of monoplane wings, which need to be thickened at the root in order to be sufficiently strong. Tests have been carried out on such wings in order to determine the best conditions of compromise between drag and strength. The drag on aerofoils at high speeds where compressibility of the air becomes of importance has been measured directly on a balance and indirectly by measurements of the loss of momentum of the air stream at various points behind the model. The latter method is valuable since it may be applied to an actual machine in flight and hence allow of the separation of the scale effect and the compressibility effect in going from the model to the full-scale machine.

At the other end of the scale, the stability of aircraft at low speeds is receiving considerable attention, and the effect of slots and flaps and other landing devices is being studied. A demonstration was given of a model being tested in this way. The model is given a slow rolling motion, and measurements are made to determine whether such motion tends to be checked or accentuated. In order to verify a simple empirical formula which has recently been suggested for predicting flutter speed from the resonance frequency of a wing in still air, various types of wing have been under test in order to determine to what extent a numerical factor in the formula varies with the types of wing generally used.

In the Yarrow Tank of the William Froude Laboratory, experiments were being conducted on a self-propelled model cargo vessel, the rolling of which was measured continuously from an initial angle of heel. The tests are being made to differentiate between various types of keels and their position on the hull, and also to throw light on the effect of factors of design upon the extinction of rolling.

The effect of rate of revolution of twin-screw propellers on their propulsive efficiency has recently been studied. The results show that for any given pair of screws, there is an optimum speed of rotation at which this efficiency is a maximum. In addition to these exhibits, a variety of instruments for making tests on models and full-sized ships was exhibited.

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# South-Eastern Union of Scientific Societies

## Annual Congress at Oxford

THE South-Eastern Union of Scientific Societies met for the first time in its history at Oxford on the occasion of its forty-first annual congress on June 30–July 4. Prof. G. D. Hale Carpenter, Hope professor of zoology at the University, occupied the presidential chair. The congress was held under the patronage of the Vice-Chancellor of Oxford, A. D. Lindsay, Master of Balliol College, and the Pro-Vice-Chancellor, the Warden of Wadham, welcomed the members at Rhodes House at its first meeting.

Prof. Hale Carpenter chose as the subject of his address "Charles Darwin and Entomology". The subject was, he said, of peculiar interest at Oxford, for his predecessor in the Hope professorship, Sir Edward Poulton, had made Oxford the centre for the study of the Darwin-Wallace theory of natural selection, as applied to the coloration and evolution of insects. This could only be explained on that theory. Sometimes it pays an insect to change its appearance according to whether it appears in a dry or a wet season. Poulton pointed out that a dry season is one of scarcity of food, and certain butterflies then remain inconspicuous, and of skulking habits, whereas in a wet season they are quite conspicuously coloured, and they can afford to allow some of the species to be eaten by reason of their numbers. Prof. Hale Carpenter referred to a species (*Charaxes zoolina*) from Africa which is conspicuous in the wet season, but in the dry season assumes a dead-leaf brown, and deliberately hides itself amongst clusters of dead leaves. Such cases afford support to Darwin's theory. It was customary for early entomologists to assume that coloration of the kind was due to the foresight of a beneficent Creator, and many statements were quoted from their writings to show this point of view, although Erasmus Darwin had some very pertinent remarks suggesting that variations in colours had some greater meaning than had then been discovered.

The clarification of the whole subject came when Darwin formulated his theory of natural selection and the preservation of favoured races in the struggle for life. This added zest to the study of entomology and revolutionized the older views. In spite of the rejection of the theory by some biologists nowadays, Prof. Hale Carpenter remarked, "No explanation has yet been put forward which covers the facts of the coloration of insects so well as does the theory of natural selection". Bates first gave a rational explanation of what he called mimetic analogy, now usually termed mimicry. Certain insects will mimic the outward form of others that are distasteful, and the enemy will avoid them, although not really distasteful. At the root of the matter lies the question of memory, and the assumption is that some of their enemies have recollections of distastefulness. "A variation which assumed a mimetic form has a better chance of surviving to reproduce its like by the laws of heredity, and an initial slight resemblance may be perfected into astonishingly detailed mimicry".

In his address to the Botanical Section, Mr. A. J. Wilmott spoke on the "Endemic Flora of Britain". He controverted the generally-accepted theory that the flora of Britain was exterminated in the Ice Age some ten thousand years ago. He held that at its height there were probably many nunataks where plants took refuge, apart from those parts of southern England which were never in their entirety and at one and the same time covered by ice. In addition, there were four interglacial periods during which there was amelioration of climate, when plants could obtain any foothold that they had lost during the severe periods of glaciation. Considerable migration from place to place was evident, during which there was possibly an "orgy of variation". It was mentioned that ten years' work on the compilation of a new flora of Sussex, commenced at the Hastings Congress in 1927, had now brought publication within view, and subscribers and contributions towards publication were needed.

In the Zoological Section, Lord Mansfield gave an address on "Bird-Ringing and Bird Migration". He said that a very small proportion of rings is ever returned, and an endeavour is to be made to reach the peasantry of various lands who never read pamphlets or newspapers, and thus know nothing of the value of the rings that they collect. Experiments he had made have shown that it is not only the desire to avoid cold climates that gives the impetus to migration. A canary and other birds when supplied with food have been seen feeding in the snow in Canada. Birds kept in an aviary have been found to wake up at night, whenever an electric light was turned on, and feed eagerly, birds' digestions being of a rapid nature. Food is what migrants have in view rather than the avoidance of cold. Reference was made to the endeavour now being carried out to induce the breeding of storks in England, and a report promised for next year's Congress. Mr. E. M. Nicholson spoke on the progress of the British Trust for Ornithology.

Of considerable interest and value is the report of the Insect Immigration Committee, conducted under the energetic guidance of Capt. T. Dannreuther. Observers all around the coast have been enlisted in this work, including by permission of Trinity House the occupants of lighthouses and lightships. The greater number of observations of the presence of certain butterflies and moths on land do not demonstrate migratory movements, and thus those made at sea or by the shore have the greater value. Actual movements in definite directions are greatly needed, and thus continuous watch by observers is asked for. In May 1933, undoubted immigrations were noted of *Vanessa atalanta*, which were seen arriving from over the sea on the south coast. These established themselves as far north as Thurso. After September they decreased rapidly in the north, but became more common in the south than at the height of summer. In 1935 the decline in the north was more gradual. *Cardui* (painted ladies) were scarce in 1933 in the Highlands, though common in southern Scotland, and it was noticeable that when they had disappeared, *V. atalanta* still remained common. Much work remains still to be done, and additional observers are needed in this fascinating work.

In the Geological Section, Dr. Dighton Thomas read a paper on "Geology and the Community", and showed how the science touches the common interests of all classes. Much money has been wasted in the past in the search for water, coal and oil, where a little geological knowledge would have avoided the waste. Municipalities are not even now alive to the necessity of taking expert advice about such matters.

Many excursions were made to places of scientific interest. Archæologists visited the Cotswold churches of Fairford, Bibury, Burford and Faringdon. Botanists and zoologists went to the Ruskin Reserve at Cothill, where marsh, fen and aquatic plants were found. Three rounds of visits were made to Oxford colleges, the Bodleian, the Sheldonian, and the Museum of the History of Science, where Dr. R. T. Gunther explained the treasures of the Old Ashmolean.

It was announced that the Congress in 1937 would be held at Hastings under the presidency of Prof. F. E. Weiss, formerly George Harrison professor of botany in the University of Manchester.

## Educational Topics and Events

BIRMINGHAM.—At the annual degree congregation, honorary degrees were conferred on Mr. W. B. Grove, a well-known mycologist, and Mr. A. E. Hills, a Birmingham manufacturer to whose generosity the University owes the new chemistry building now being erected.

CAMBRIDGE.—T. R. B. Sanders, of Corpus Christi College, has been appointed University lecturer in engineering.

W. W. Brigden, of King's College, has been elected to the Marmaduke Sheild Scholarship in anatomy. Frank Smart Prizes have been awarded to G. Metcalfe, of Clare College (Botany), and E. T. Burtt, of King's College (zoology).

At Magdalene College, Dr. D. W. Babbage, research fellow of the College and University lecturer in mathematics, has been elected into an official fellowship.

EDINBURGH.—At a graduation ceremonial on July 3 the honorary degree of Doctor of Laws was conferred on the following, among others: Sir Thomas Hudson Beare, professor of engineering and dean of the Faculty of Science in the University; Sir William W. M'Kechnie, lately secretary to the Scottish Educational Department; Prof. Edward L. Thorndike, professor of education, Teachers' College, Columbia University, New York.

OXFORD.—Dr. J. H. C. Thompson, research fellow of Merton College, and formerly of New College, has been elected fellow of Wadham College and lecturer in mathematics—a new appointment.

ST. ANDREWS.—Mr. John N. Wright has been appointed to the chair of logic and metaphysics, vacated by Prof. G. F. Stout. Mr. Wright was appointed assistant to Prof. Stout in the United College in 1920, and in 1924 became lecturer in philosophy in University College, Dundee.

Mr. T. Malcolm Knox, fellow and tutor of Jesus College, Oxford, has been appointed to the chair of moral philosophy vacant by the death of Prof. David Morrison. From 1924 until 1931 he was secretary to Lord Leverhulme, but was appointed in 1931 to a lectureship in philosophy at Jesus College, Oxford. He was junior dean and librarian of his College, a member of the Sub-Faculty of Philosophy, and a member of the Oxford University Appointments Committee.

## Science News a Century Ago

### John Ericsson's Screw Propeller

On July 13, 1836, six weeks after F. P. Smith patented his screw propeller, John Ericsson, the famous Swedish engineer, also secured a British patent for a screw propeller, but of a very different design. Ericsson's propeller consisted of two drums each carrying on its exterior helical blades; the blades of each drum being inclined in opposite directions, so that one screw was 'left-handed' and the other 'right-handed'. The drums were fitted tandem-fashion behind the rudder and the invention included an arrangement by which the drums were revolved in opposite directions. The object of the duplex arrangement was to avoid loss due to the rotary motion imparted to the water by a single screw.

Ericsson fitted his propeller to the *Francis B. Ogden* in 1837 and the *Robert F. Stockton* in 1838. In 1837 the *Francis B. Ogden* towed the Admiralty barge from Somerset House to Blackwall and back. Ericsson, however, received no encouragement and afterwards learnt that Sir William Symonds, Surveyor of the Navy, had remarked that "even if the propeller had the power of propelling a vessel it would be found altogether useless in practice, because the power being applied at the stern, it would be absolutely impossible to make the vessel steer."

### Biot at the Collège de France

In its column of "Miscellanea", the *Athenæum* of July 16, 1836, said: "The learned and scientific M. Biot has been delivering some very remarkable lectures at the Collège de France. He has proved, that, by means of polarized rays, it is possible to ascertain the chemical action which takes place between bodies held in solution in various liquids; an action which has not yet been discovered by less delicate means. This is a new branch of science, created as it were by this great natural philosopher, from which the most important and curious results may be expected."

### Sir John Herschel and Mr. Somerville

Writing to Mr. Somerville from "Feldhausen near Wynberg, C.G.H." on July 17, 1836, Sir John Herschel, referring to the honour which had been paid Mrs. Somerville, said, ". . . Though what she has performed may seem so natural and easy to herself, that she may blush to find it fame; all the rest of the world will agree with me that merit of that kind is felt and recognised at length in the high places of the earth. . . ."

"We are all," he continued, "going on very comfortably, and continue to like the Cape as a place of (temporary) residence as much or more than at first. The climate is so very delicious. . . The stars are most propitious, and astronomically speaking, I can now declare the climate to be most excellent. Night after night, for weeks and months, with hardly an interruption, of *perfect* astronomical weather, discs of stars reduced almost to points, and tranquilly gliding across the field of your telescope. It is really a treat, such as occurs once or perhaps twice a year in England—hardly more. I had almost forgotten that by a recent vote of the Astronomical Society I can now claim Mrs. Somerville *as a colleague*. Pray make my compliments to her in that capacity, and tell her that I hope to meet her there at some future session. . ."

## Societies and Academies

### Paris

Academy of Sciences, June 2 (*C.R.*, **202**, 1826–1880).

L. E. Dickson: Solution of Waring's problem.

Jean Cabannes and Auguste Rousset: Measurement of the factor of depolarization of the Raman lines in gases: nitrogen, oxygen, carbon dioxide.

Geza Kunetz: Some properties of characteristic functions.

Alfred Rosenblatt: The conformal representation of restricted domains limited by general curves.

A. Toussaint and S. Pivko: Free plane stream. The influence of the supporting wings on the aerodynamical characteristics.

Georges Sabathe: The origin and suppression of the discontinuity in the hydrodynamic resistance of the floats of flying boats.

Victor Maitre: The colour of stars of the spectral types $A0$, $A2$. The hypotheses of a distance effect and an effect of absolute magnitude have been examined separately. From a study of 335 stars of types $A0$ and $A2$, the results can be better interpreted as due to an effect of absolute magnitude than as a distance effect. An examination of the $B$ type stars will follow.

W. Arkadiew: The magneto-dynamic relation between the viscous losses and the permeability in very weak fields.

Théodore V. Ionescu: Luminous discharges observed in the magnetic field at pressures below $10^{-4}$ mm. of mercury. Detailed description of the light effects observed under varying conditions of voltage and magnetic field. The theory of the phenomena is not discussed.

Léon Capdecomme: The role of the parasite flux in measurements of reflective powers carried out with the aid of the microscope.

André Morette: The melting point of vanadium oxychloride and vanadium tetrachloride. The thermal analysis of the system chlorine – vanadium tetrachloride. The melting point of the tetrachloride is $-77° \pm 2°$ C. and of the oxychloride, $-28° \pm 2°$ C. The results of the thermal study of the system chlorine, vanadium tetrachloride are given graphically; they show no indication of the existence of a vanadium pentachloride.

René Wurmser and Mme. Sabine Filitti-Wurmser. The equilibrium between isopropyl alcohol and acetone in the presence of alcohol-dehydrase.

Mme. Marie Freymann and René Freymann: The infra-red absorption and Raman spectra of amides and anilides and the structure of these compounds. The conclusions lead to structures differing from the classical formulæ, and favour the hypothesis of chelation already suggested by several authors.

Raymond Amiot: The adsorption of binary mixtures of acetic acid and of some alcohols in aqueous solution.

Maurice Engeldinger: The study of a colloidal solution prepared starting with resorcinol – formol resins.

Mme. Léone Walter-Lévy: Contribution to the study of the basic magnesium sulphates.

Charles Dufraisse and Marcel Gérard: Dissociable organic oxides and anthracene structure. The properties of photo-oxyanthracene. From its

chemical reactions, photo-oxyanthracene resembles anthrahydroquinone and oxanthrone, with which it is isomeric, but differs in its oxidizing power due to the peroxide function.

GEORGES DUPONT and RAYMOND DULOU: The pyronenes.

A. P. ROLLET: The polymorphism of potassium pentaborate, $K_2O.5B_2O_3$.

PHILIBERT RUSSO: The Lias at the northern extremity of the Middle Atlas.

JOSUÉ-HEILMANN HOFFET: The discovery of the Cretaceous in Indo-China.

AIMÉ RUDEL: The flora, fauna and origin of the peperites of the Puy-de-Mur (Limagne d'Auvergne).

MARCEL GAUTIER: The palæogeography of the Nemours (Algeria) region.

H. GRISOLLET: Study of the light diffused by particles in suspension in the air.

ONG SIAN GWAN: The presence of sensitizing antispermatozoids in the blood of man and of woman.

## Melbourne

### Royal Society of Victoria, May 14.

ANN NICHOLLS: The mineralogy of the sand fractions of some Victorian soils. A microscopical study of the fine sand fractions of some Victorian soils has indicated that soils on the Jurassic rocks contain abundant orthoclase and plagioclase, suggesting that they are immature. Basaltic soils show quartz, zircon, tourmaline and sponge spicules, which must be due to the addition of foreign material by the wind. The amount of basaltic material present depends on the state of maturity of the soil, as determined by the age of the basalt flow and the slope on which the soil is developed.

R. T. PATTON: A fossil *Casuarina* from near Bacchus Marsh, Victoria. Small teeth-like leaves, grooves on the branchlets and fruits are excellently preserved in beds which may be Miocene, as they overlie Oligocene lignites.

A. B. EDWARDS: Occurrence of almandine garnets in some Devonian igneous rocks of Victoria. Almandine is a characteristic mineral in those Upper Devonian rhyo-dacites of Victoria the magmas of which, at the time of their extrusion, had reached a state of 'silica saturation' in excess of the requirements of their ferromagnesian minerals and felspars. With further crystallization of the magma, the garnet became unstable owing to a dwindling ferromagnesian concentration, and broke down into more stable minerals, such as cordierite and biotite. Because of this, garnets are rare in granitic rocks, except in association with basic xenoliths. This process is not substantially affected by assimilation, so that the garnets appear to be pyrogenetic minerals of a 'discontinuous reaction' type.

## Washington, D.C.

### National Academy of Sciences, *Proc.*, 22, 249–326, May 15.

EDISON PETTIT: A second law of the motions of eruptive prominences. These prominences rise from the chromosphere and disappear at great heights during intervals of a few minutes or hours. They rise with uniform motion, modified at intervals by sudden increases as though receiving occasional impulses. From the records of thirty-eight such prominences, it is deduced that, when this sudden increase of velocity occurs, the new velocity is always a small multiple of that immediately preceding it.

C. D. LA RUE: The effect of auxin on the abscission of petioles. When the leaf-blades of *Coleus* and *Ricinus* are removed, the petioles develop an absciss layer within a few days, and fall off. Several substances known to contain the growth hormone, applied in agar-agar or lanolin, delay formation of the abscission layer; the most effective is synthetic hetero-auxin in lanoline. Their effect is greater if the plant is kept in the dark.

CHESTER STOCK: Perissodactyla of the Sespe Eocene, California.

F. ZWICKY: Extra-terrestrial effects of cosmic rays. Such effects have not hitherto been investigated. It is estimated that the total intensity due to light, atomic and cosmic rays in space is greater than $10^{-3}$ ergs/cm.$^2$ sec. Discussing in particular the long-period variable stars, which have comparatively low surface temperatures, it is suggested that the emission by these stars of the Balmer lines with high intensity may be due to the absorption of such interstellar energy. It is also possible that the mechanical behaviour of extended gas and dust clouds in interstellar space (sharp outlines observed) may be due to corpuscular rays.

C. M. POMERAT and M. X. ZARROW: The effect of temperature on the respiration of the earthworm. Respiratory measurements over the range 9°–27° C. on normal worms, and also on worms from which the supra- or subœsophageal ganglion had been removed, show that there is an increase in rate of gas exchange with rise of temperature, as in other animals the body temperature of which is variable.

H. G. DU BUY: The change in the response of oat coleoptiles to growth regulators produced by aging. Response decreases with age at all concentrations of auxin, and the threshold concentration for curvature increases with age. The plants are sensitive to auxin only at a certain stage of development, the duration of which can be varied.

ROBERT M. YERKES and JAMES H. ELDER: The sexual and reproductive cycles of chimpanzee. Data are given from daily observations of animals at the Yale Laboratories of Primate Biology, and include records of behaviour and reproductive outcome of more than five hundred controlled matings. The sexual cycle is approximately five weeks and the period of gestation eight months.

B. D. BURKS: The nearctic Dirhinini and Epitranini (Hymenoptera, Chalcididæ). These parasitic flies exhibit great variations of structure. They are accordingly divided into five tribes, two of which are discussed and keys given.

G. A. MILLER: Groups in which the squares of the operators generate a cyclic group.

EDWARD V. HUNTINGTON: Mathematical postulates for the logical operations of assertion, conjunction, negation and equality.

SUMNER BYRON MYERS: Isometries of 2-dimensional Riemannian manifolds into themselves.

J. W. ALEXANDER: On the connectivity ring of a bicompact space.

EDWARD KASNER and GEORGE COMENETZ: Conformal geometry of horn angles.

T. Y. THOMAS: On normal co-ordinates.

MARSTON MORSE: Functional topology and abstract variational theory.

W. V. QUINE: A theory of classes presupposing no canons of type.

## Forthcoming Events

FIFTH CONGRESS OF UNIVERSITIES OF THE BRITISH EMPIRE, July 13–17.—To be held at Cambridge. The Right Hon. Stanley Baldwin: President.

July 15, at 10 a.m.—G. H. A. Wilson: "Some Problems which confront Universities".

July 15, at 11.—(1) Discussion on "Provisions in Great Britain for Postgraduate Studies for British and Overseas Students", to be opened by the Right Hon. Lord Macmillan. (2) Discussion on "Functions of Universities in the Training of Teachers", to be opened by Sir Percy Nunn.

July 16, at 10 a.m.—The Hon. H. J. Cody: "The Relation of Canadian Universities to National Life".

July 16, at 11.—(1) Discussion on "Careers for University Students", to be opened by O. V. Guy. (2) Discussion on "General as an Alternative to Specialised Honours Courses", to be opened by Sir Charles Grant Robertson.

July 17, at 10 a.m.—The Right Hon Oliver Stanley: "The Relation of Secondary Education to the Universities".

July 17, at 11.—(1) Discussion on "University Examination Methods", to be opened by Dr. A. W. Pickard-Cambridge. (2) Discussion on "Physical Education in the Universities", to be opened by Dr. Carleton Stanley.

WOMEN'S ENGINEERING SOCIETY, July 17–20.—Fourteenth Annual Conference to be held in the University of Leeds.

July 17, at 7.—Mrs. J. A. Mollison: Presidential Address.

BRITISH MEDICAL ASSOCIATION, July 17–25.—Annual Meeting to be held in Oxford.

Sir E. Farquhar Buzzard: President.

## Official Publications Received

### Great Britain and Ireland

Department of Scientific and Industrial Research. Catalogue of Types and Figured Specimens of Fossils in the Geological Survey Collections, now exhibited in the Royal Scottish Museum, Edinburgh. By Dr. E. M. Anderson. Pp. 77. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [196

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Investigations on the Improvement of Hill Grazings. 1: The Scope of the Work, by R. G. Stapledon; 2: The Introduction and Maintenance of Nutritious and Palatable Species and Strains, by M. T. Thomas; 3: The Buried Viable Seeds of Enclosed and Unenclosed Hill Land, by W. E. J. Milton. (Series H, No. 14, Seasons 1930–1935.) Pp. iii+86. (Aberystwyth: University College of Wales.) 3*s.* 6*d.* [19

Department of Scientific and Industrial Research. Forest Products Research Records, No. 10: The Practice of Wood Bending. By W. C. Stevens. Pp. ii+9+2 plates. (London: H.M. Stationery Office.) 6*d.* net. [226

The British South Africa Company. Publication No. 4: Mazoe Citrus Experimental Station; Annual Report for 1934. Pp. xvi+133+5 plates. (London: British South Africa Co.; Mazoe: Citrus Experimental Station.) [236

First Annual Report of the Inland Water Survey Committee, 1935–36. Pp. 16. (London: H.M. Stationery Office.) 3*d.* net. [246

Imperial Economic Committee. Fruit Supplies in 1935, including Vegetables, Flowers and Bulbs; a Supplement to Weekly Fruit Intelligence Notes prepared in the Intelligence Branch of the Imperial Economic Committee. Pp. 100. (London: H.M. Stationery Office.) 2*s.* 6*d.* net. [246

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 3, No. 27: The Development of the Legs, Wings and Halteres in Wild Type and some Mutant Strains of *Drosophila melanogaster*. By Dr. Charlotte Auerbach. Pp. 787–815+1 plate. 4*s.* Vol. 58, Part 3, No. 28: The Blood Vascular System of the Elasmobranch Fish *Squatina squatina* (Linné). By B. J. Marples. Pp. 817–840. 3*s.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.). [256

The Unseen Net: an Outline of the Plan to destroy British Liberties and to enthrone Political and Economic Plutocracy. Pp. 16. (London: Liberty Restoration League.) 3*d.* [256

Facilities available at University Institutions of Great Britain and Ireland: a Handbook of Information for Overseas Students. Pp. 68. (London: Universities Bureau of the British Empire.) 1*s.* 6*d.* [256

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1935 May 1—1936 April 30. Pp. 4. (Cambridge: The Observatory.) [296

### Other Countries

Canada: Department of Mines: Mines Branch. Natural Bonded Moulding Sands of Canada. By Correll H. Freeman. (No. 767.) Pp. vi+144+11 plates. (Ottawa: Government Printer.) 25 cents. [156

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 6, No. 12: Re-Examination of 64 Orbits. By W. E. Harper. Pp. 207–260. Vol. 6, No. 16: The Orbit of the Spectroscopic Binary Boss 4217. By Andrew McKeller. Pp. 291–295. (Ottawa: King's Printer.) [156

Statens Meteorologisk-Hydrografiska Anstalt. Tillhör Årsbok 17, 1935: Årsberättelse för 1935. Pp. 21. Årsbok 15, 1933. iii. Vattenständen vid Rikets kuster. Pp. 23. 2.00 kr. Årsbok 16, 1934. v. Hydrografiska mätningar i Sverige. Pp. 12. 3.00 kr. Årsbok 17, 1935. 1. Månadsöversikt över väderlek och vattentillgång. Pp. 76. 2.50 kr. Årsbok 17, 1935. ii. Nederbörden i Sverige. Pp. 55. 2.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [156

Cawthron Institute, Nelson, New Zealand. Annual Report, 1935. Pp. 18. (Nelson: Cawthron Institute.) [176

Instytut Geofizyki i Meteorologji: Uniwersytetu Jana Kazimierza we Lwowie. Komunikaty, Tom 8, Nr. 93 do 109: Wyników prac Henryka Arctowskiego i jego współpracowników Natalji Chareckiej, Adama Kochańskiego, Kazimierza Korczaka, Henryka Orkisza, Jana Teśli, Wacława Wiszniewskiego i Adama Żyśki. (Des résultats des recherches de Henryk Arctowski et de ses collaborateurs.) Pp. iv+427. (Lwów: Instytut Geofizyki i Meteorologji.) [176

Svenska Linné-Sällskapets Årsskrift. Årgång 19, 1936. Pp. v+155. (Uppsala: Almquist and Wiksells Boktryckeri A.-B.) [186

Canada: Department of Mines: Bureau of Economic Geology, Geological Survey. Memoir 183: Geology of Chaleur Bay Region. By F. J. Alcock. (No. 2398.) Pp. iv+146+16 plates. 50 cents. Memoir 187: Rae to Great Bear Lake, Mackenzie District, N.W.T. By D. F. Kidd. (No. 2410.) Pp. ii+44. 25 cents. Memoir 188: The West Half of Wildcat Hills Map-area, Alberta. By G. S. Hume. (No. 2412.) Pp. ii+15+2 plates. 10 cents. (Ottawa: King's Printer.) [186

Canada: Department of Mines: National Museum of Canada. Bulletin No. 79 (Biological Series No. 21): The Freshwater Mollusc *Helisoma corpulentum* and its relatives in Canada. By F. C. Baker. Pp. 37 (5 plates). 25 cents. (Ottawa: King's Printer.) [186

Transactions of the San Diego Society of Natural History. Vol. 8, No. 18: Notes on Birds in relation to the Faunal Areas of South-Central Arizona. By A. J. van Rossem. Pp. 121–148+plates 17–18. Vol. 8, No. 19: *Crotalus mitchellii*, the Speckled Rattlesnake. By Laurence M. Klauber. Pp. 149–184+plates 19–20. (San Diego, Calif.: San Diego Society of Natural History.) [196

U.S. Department of the Interior: Office of Education. Bulletin 1935, No. 9: Public Education in the Philippine Islands. By Katherine M. Cook. Pp. 53. 10 cents. Bulletin 1935, No. 11: Education in Czechoslovakia. By Severin K. Turosienski. Pp. vii+181. 25 cents. Bulletin 1936, No. 1: Educational Directory, 1936. (In 4 parts.) Pp. iii+44+28+54+64. Vocational Education Bulletin No. 184 (Rehabilitation Series No. 24): Procedure for Survey of a State Program of Vocational Rehabilitation. Pp. viii+82. 10 cents. (Washington, D.C.: Government Printing Office.) [196

Trees and Shrubs of Kenya Colony. A Revision and Enlargement of "A Descriptive Catalogue of some of the Common Trees and Woody Plants of Kenya Colony by E. Battiscombe". Pp. xi+201. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 5*s.* [226

Yale University Publications in Anthropology. Nos. 1–7. Pp. 20 + 19 + 22 + 26 + 19 + 14 + 23 + 1 plate. (New Haven, Conn.: Yale University Press; London: Oxford University Press.) 9*s.* net. [226

Smithsonian Miscellaneous Collections. Vol. 95, No. 9: Preliminary Observations on Growth and Phototropic Response of Oat Seedlings. By Enoch Karrer. (Publication 3389.) Pp. ii+4. (Washington, D.C.: Smithsonian Institution.) [226

Annual Report of the Imperial Council of Agricultural Research for the Year 1934–35. Pp. iii+109. (Delhi: Manager of Publications.) 1 rupee; 1*s.* 9*d.* [226

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 55: The Petrology of the Prospect Porphyritic Gneiss of Connecticut. By Lincoln Stewart. (Public Document No. 47.) Pp. 40+8 plates. (Hartford, Conn.: State Geological and Natural History Survey.) 50 cents. [226

Transactions of the National Institute of Sciences of India. Vol. 1, No. 8: Studies in the Electron Theory of Solid Metal. By N. K. Saha. Pp. 125–185. (Calcutta: National Institute of Sciences of India.) 4 rupees. [226

Proceedings of the United States National Museum. Vol. 83, No. 2989: Three New Millipeds of the Order Colobognatha from Tennessee, Texas and Lower California, with Records of previously known Species. By H. F. Loomis. Pp. 361–368. (Washington, D.C.: Government Printing Office.) [226

Doenças das Aves (Tratado de Ornithopathologia.) Por J. Reis e P. Nobrega, com a collaboração de A. S. Reis. Pp. vi+469. (Sao Paulo: Instituto Biologico.) [226

Smithsonian Miscellaneous Collections. Vol. 95, No. 11: Influence of Planetary Configurations upon the Frequency of Visible Sun Spots. By Fernando Sanford. (Publication 3391.) Pp. ii+5. (Washington, D.C.: Smithsonian Institution.) [246

### Catalogues

Radiovisor Smoke Alarm Equipment. Pp. 8. (London: Radiovisor Parent, Ltd.)

British Made Mercury Switches. (List No. 1636.) Pp. 16. (London: Isenthal Automatic Controls, Ltd.)

Catalogue of the Newton Papers sold by order of the Viscount Lymington to whom they have descended from Catherine Conduitt, Viscountess Lymington, Great Niece of Sir Isaac Newton. Pp. 144. (London: Sotheby and Co.)

A Visit to our Showrooms at Aldwych House. (No. 1.) Pp. 20. (London: J. H. Sankey and Son, Ltd.)

Philips Technical Review. Vol. 1, No. 3, March. Pp. 65–96. Vol. 1, No. 4, April. Pp. 97–128. (Eindhoven: Philips Laboratory.)

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# Science in the Public Press

THE desirability of promoting a more intelligent and more intelligible consideration of scientific work and thought in the public Press has often been urged in these columns; and there are signs of increased attention to this need both from newspaper editors and from scientific workers. This is due to several causes. The public expenditure upon scientific research is now large. Government departments which spend money on research, and scientific workers who are supported by public money, feel that the public should understand the value of the work it is supporting. This motive of social self-justification penetrates far more extensively than is generally realized. The Department of Scientific and Industrial Research and the University Grants Committee provide funds which assist a large fraction of all the scientific research at present done in Great Britain.

The circumstances of scientific research in this country have undergone a profound change during the last fifty years. In the nineteenth century, the leaders of research did not consider that social justification of their work was necessary. Providence had placed them in fortunate situations where they were able to indulge their personal intellectual tastes, and though their labours might be of practical value to humanity, or profitable to themselves, this was regarded as a happy accident. They considered that the receipt of a comfortable academic salary or private income did not lay any very pressing obligation on them to use their talents for the extension of scientific knowledge to the community. This attitude was derived from an earlier stage of civilization, when humanity was forced to admire those who could exact support without rendering any corresponding service.

The Greeks despised Archimedes' contributions to mechanics because manual skill in a slave State was disreputable. Until recently a large part of scientific research was done by persons enjoying academic endowments or private fortunes. As they were not directly dependent on the public, they did not see why they should explain what they were doing. In extreme cases, such as that of Henry Cavendish, they did not explain what they were doing even to their friends. A scientific worker in direct receipt of a subsidy cannot reasonably adopt this attitude.

The policy adopted by large industrial corporations of supporting research in order to invent valuable new processes has provided another motive for the extension of public interest in science. Many corporations systematically publish accounts of their researches, partly as a form of advertisement to show their progressive character. They are interested in securing as much public discussion as possible of the scientific principles connected with the goods they wish to sell. In the United States especially, a large amount of advertisement is designed to appeal to the scientific interests of consumers.

The rapid increase in the number of scientific inventions, such as radio, aeroplanes, synthetic plastics, and thousands of other modern objects, attracts the scientific curiosity of the public. In addition, there are the results of decades of the teaching of science in schools, and the spread of the conviction that science is the chief characteristic of the present age. It can scarcely be admitted, however, that the present age is scientific, though science may be prominent in it. Indeed, the development of science throws into greater contrast the unscientific nature of the greater part of modern life. Nothing could be more unscientific

than the contemporary armaments race, and the existence of widespread poverty and malnutrition in a period of unparalleled development of the technique of production, and the study of the science of nutrition. An increasing number of citizens are looking to the public Press for explanations of these paradoxes.

It is not necessary to enumerate more reasons why the demand for news and information of science in the Press is increasing. The fact is known to every newspaper editor. Some are puzzled by it, and accept it merely on business grounds. Recent questionnaires on the popularity of different types of articles have shown that scientific articles are more popular than many editors with a literary training had believed.

While nearly everyone admits the increasing demand for news of science, there is general agreement that the demand is not being met satisfactorily. Scientific workers are irritated by inaccurate Press accounts of their activities, and the public is unable to hear of many matters it would like to know. Better methods of handling science in the Press are required. For various reasons the problem is difficult. The mere technical difficulty of explaining science in a style suitable for a newspaper, and yet not obnoxious to men of science, is considerable. The difficulty of popularization is generally underrated. Good popularization requires a breadth of culture in the writer which is not very common among scientific workers, or any section of the population. Few men of science are immediately capable of writing for the Press. In fact, it may be confidently asserted that it is more difficult to earn £300 per annum in writing satisfactory scientific articles for the Press than to earn an equal sum as a research worker. This is one of the explanations why so much newspaper matter relating to science is so bad.

The poor financial rewards of scientific journalism have repelled most able men from the work. The field has been left to a small group which contains an exceptionally large percentage of writers who, for one reason or another, do not fit in very well with the usual professions, where equivalent qualifications can usually command an income of £750 a year in an academic or industrial post. Until newspapers are prepared to pay such a salary for a full-time science editor, they will remain without a representative of science with standing equal to that of a literary editor. The problem is thus, to a large extent, economic.

The creation of a science news agency, like Science Service in the United States, seems to be a more immediately practicable, though less ideal, solution. But there are serious difficulties in creating such a service. The Press includes journals conducted on very different principles, and with very different points of view. The technique of writing for different types of journal varies greatly. Some writers are brilliantly successful with one type of journal, and are complete failures with others. Newspapers are very competitive. Editors in Great Britain always like to have some individuality or exclusiveness in their copy: they use matter from the Press agencies only when they are unable to get special material of their own. Thus a news service tends to start with the neutral characteristics of a stop-gap organization. But though there are difficulties confronting the establishment of a science news service, such a service is particularly necessary in the absence of adequate science reports in the Press, and will always have a useful function, for the same reasons which keep the various general Press agencies in vigorous existence.

Assuming that a science news service is desirable, the next point to decide is how it may best be organized. It would be wise to be clear from the beginning who should control the service. Should the predominance of the control be with science, or with the Press? Different answers might be given to this question in different countries and circumstances. There is little doubt that in Great Britain final control should at the beginning rest with representatives of science. The organizers of such a service should seek endowments from societies and individuals, and the control should be through a committee of eminent men of science. A staff of two or three scientific journalists, whose various styles will roughly suit the various types of journal, should be appointed. A sum of £25,000, or an endowment of £3,000 a year for ten years, might be sufficient for starting the organization under conditions that might lead to great and valuable success. The payment of fairly secure and satisfactory salaries would do much to attract able men to the staff of the service. Until this is done, the presentation of science in the public Press will not be improved, because the sort of ability necessary to solve the problems of the collection and presentation of science news will be much better paid in other fields of work.

# Man and Forest in Prehistoric Europe

**The Mesolithic Settlement of Northern Europe:** a Study of the Food-Gathering Peoples of Northern Europe during the Early Post-Glacial Period. By Dr. J. G. D. Clark. Pp. xvi+284+8 plates. (Cambridge: At the University Press, 1936.) 25s. net.

THE passing of the last Ice Age left northern Europe open to human settlement; but the environment which the settlers encountered was still slowly changing. They had to adjust their equipment to land movements (including the opening of the Channel and the submergence of the Dogger Bank), to the change from a cold 'Pre-Boreal' to a warm continental 'Boreal' climate and then to a moister 'Atlantic' phase, to spread of forests, first of birch and willow, then of pine, then of mixed oak woods, and to consequent alterations in the country's fauna. Of these changes and of the geological, botanical and zoological evidence from which they are reconstructed, Dr. Clark gives a clear account, illustrated with maps and documented with copious references. The successive phases provide not only the background as adjustments to which human cultures must be interpreted, but also the chronological framework in which they must be arranged. Indeed, accepting at least the method of de Geer's geochronology, Clark provisionally offers absolute dates for the climatic phases: 6800–5000 B.C. for the Boreal, 5000–2500 for the Atlantic.

The first colonists are known almost exclusively from their flint artefacts, among which tanged points are the most conspicuous, but Rust and Schwantes found also their 'harpoons' and other tools of reindeers' antler near Hamburg just in time for inclusion in this book. A little later, axe-like and adze-like tools of reindeer antler illustrate men's first efforts at coping with the Boreal forests that were invading the tundras and steppes. Clark accepts Schwantes' thesis that these so-called Lyngby axes of antler are the prototypes of the later north European flint axes, but admits the possibility of their derivation from some still unknown culture to the south-east—a possibility that cannot be excluded while Russia remains almost unexplored. The familiar Maglemose culture (this name, signifying Great Moss, is retained for the whole complex, Mullerup being used for the facies peculiar to Zealand) can then be treated as a further adjustment to the forest environment, though the author insists that its microliths are derived from the Tardenoisian, the spread of which round the fringe of the wooded plains is discussed in a special chapter.

Otherwise the principal novelties in the treatment of the well-known complex are the illustrations of the gravers, included among the relics from the type sites but ignored until Westerby noted them in 1927, and an accurate classification of the various bone points that constitute the best-known type-fossils of the complex. Independently of Bøe (whose work presumably appeared too late for mention), Clark exposes the inaccuracy of the conventional explanation of these as harpoons. He gives a very instructive map of the distribution of selected types from England to the Baltic States (but omitting the new Norwegian finds).

Clark's treatment convincingly establishes the underlying uniformity of culture prevailing throughout the region surveyed—a uniformity that really extends beyond it at least to the Urals. But the differentiation of local groups within this unity is no less interesting sociologically; for it must reflect the crystallization of distinct social units out of an ethnic continuum in Boreal times. It is graphically illustrated by the distribution of types 7 and 14 on Clark's map, and of the Vögtland club-heads and other types recently mapped by Germans. But still more striking is the rarity of axe-like tools in the forested plains east of the Baltic, suggested to the reviewer by a recent examination of Russian collections.

Regional differentiation is more emphasized in Atlantic times. Clark establishes very convincingly the continuity between the Maglemose and Ertebølle cultures in Denmark, and the contrast between the latter and its English and Scandinavian contemporaries. The differences between Maglemose and Ertebølle are due mainly to changed environment, between Ertebølle and say Lower Halstow to the isolation consequent upon land-sinking.

Its comprehensive bibliography, its tables of sites, of fauna and of flora, and its copious and beautifully executed figures and maps, make this book a standard work on the northern mesolithic. Its author's mastery of British as well as Baltic archæology should commend it even to the most insular local antiquary. As an objective record of human adaptation to changing environments and of the divergence of industrial traditions, it possesses a wider historical interest.

V. G. CHILDE.

# Invisible Radiations of Organisms

**Invisible Radiations of Organisms**
By Prof. Otto Rahn. With an Introduction to the Physics of Radiation, by Sidney W. Barnes. (Protoplasma-Monographien, Vol. 9.) Pp. x+215. (Berlin: Gebrüder Borntraeger, 1936.) 13.20 gold marks.

HERE we behold mitogenetic radiation masquerading as the legitimate offspring of biochemistry and the quantum theory, and the unwary reader, finding 'muscle radiation' casually mentioned in a purely physical account of the photo-electric effect, may well suppose the scientific status of the two phenomena to be identical. On reaching p. 55 he may begin to suspect that in reality mitogenetic radiation was quite differently conceived; but up to this point the emission of such radiation by living cells, and even by simple systems undergoing chemical reaction, is treated as a predictable phenomenon related to chemiluminescence, and is described with the same confidence as the dispersion of light by a prism. Even the too remarkable phenomena of 'secondary radiation', involving emission of fluorescent radiation of shorter wave-length and higher intensity than the incident radiation, and its propagation, by successive phases of absorption and re-emission, through an absorbing medium, are made to appear almost as inevitable as Newton's laws of motion.

From p. 55 onwards, apart from a fair discussion of the physical detection of mitogenetic radiation, the book is biological, dealing largely with material which has already been adequately presented by Gurwitsch in his two monographs: the biological detection, phenomenology and significance of mitogenetic radiation. In addition to this, there are a few references to more recent work, accounts of experiments by the author and his collaborators, and some rather uncritical remarks about the alleged lethal effects of menstrual blood on yeast and bacteria.

A brief epilogue is devoted to the question of errors in the detection of mitogenetic radiation and to the attitude of those who remain unconvinced of its existence. Piously hoping for a *rapprochement* between believers and non-believers, Prof. Rahn does not seem to realize that his book is not likely to help in the attainment of that object. The critics ask only that a detailed re-examination of the original mitogenetic effect shall be undertaken by some of those who claim to be able to obtain positive results without difficulty; but Prof. Rahn and his Russian colleagues prefer to write redundant monographs on the ubiquity of mitogenetic radiation, to discuss it in relation to amphibian metamorphosis, parasitism, polyploidy in tomato plants, industrial fatigue, cancer and old age, and to invent queer chain reactions to hide its physico-chemical misbehaviour.

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# Properties of Iron

**The Metal—Iron**
By H. E. Cleaves and J. G. Thompson. (Alloys of Iron Research Monograph Series.) (Published for the Engineering Foundation.) Pp. xii+574. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 36*s*. net.

TO the valuable series of monographs on the alloys of iron, issued by the Engineering Foundation, there has now been added a volume dealing with the production and properties of the parent metal in a state approaching purity. Although iron is used in far larger quantities in industry than any other metal, and is not obtainable commercially in such a pure condition as several other metals, such as aluminium and zinc, our knowledge of its exact properties is still very imperfect. There are two main reasons for this fact. With its high melting point and great chemical activity, iron readily absorbs impurities when in the molten state, which are correspondingly difficult to remove, whilst its properties are exceptionally influenced by the presence of even very small quantities of foreign elements. The properties assigned to 'pure' iron in the text-books are mostly derived from commercial materials regarded as approximately pure, or by extrapolation from a series of samples with diminishing amounts of impurity. The results are in either case unsatisfactory.

The present work, by two members of the staff of the U.S. Bureau of Standards, covers the

subject very thoroughly, and the volume is indispensable to the scientific metallurgist. The methods used in the laboratory and on the technical scale for the purification of iron are described, and the properties of the purified products reviewed, the treatment being critical throughout, with a useful short survey of the results at the end of each chapter. Electrolysis is commonly resorted to for purification, and this method successfully removes most of the impurities, except nickel and cobalt, but when the deposited metal is brought into a workable form by melting, new opportunities of contamination occur. Published analyses are not a satisfactory guide. As the authors point out, the formidable list of impurities recorded by some workers using refined analytical methods may not indicate that their metal was less pure than other samples, but may be merely evidence of more scrupulous analysis. The work was completed just too soon to include the careful work of Adcock and Bristow, who obtained an exceptionally pure product, using a chemical method followed by repeated fusion in hydrogen and *in vacuo* in vessels of pure alumina.

Much engineering research has been carried out on ingot iron, a low-carbon variety of mild steel which is always segregated, and contains many inclusions. In recent years, carbonyl iron, prepared by decomposing the vapour of iron carbonyl and sintering the product without fusion, has become available, and is the purest form of iron commercially produced at present; but the cost is relatively high.

The chapters on the physical properties of iron, including the effects of small quantities of each of the impurities usually found in the metal, are most interesting. The allotropic changes occur in even the purest iron, and do not, as was at one time suggested, disappear on the removal of impurities. The magnetic properties are extremely sensitive to minute traces of foreign elements, but in a fashion which does not allow of extrapolation. The difficult subject of corrosion is discussed, the conclusion being drawn that the chemical composition is of less importance than external conditions. It is surprising, in view of the large amount of work included in this review, that the important researches of Bengough and his colleagues are not mentioned, and Bengough's name does not even appear in the excellent bibliography, arranged chronologically, and containing 1,081 references.

Pure iron is a very soft metal, and it is interesting to observe how small is the quantity of an added element which is necessary to give it appreciable hardness. It is this fact which gives to the metallography of iron a special importance, and the system iron–carbon, in particular, has attracted more workers than any other system of metallic alloys. In order to understand the properties of the alloys of iron, it is essential to know those of the pure metal, and the authors have rendered a service in making available a detailed and, on the whole, judicial survey of the whole of this difficult field of study.

C. H. D.

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# Science and Minerals in the U.S.S.R.

**The Scientific Study of Soviet Mineral Resources**
By A. E. Fersman. Edited by C. P. Dutt. Pp. 149+15 plates. (New York: International Publishers, n.d.) n.p.

THE purpose of this book, as stated in the introduction, is to give a brief outline of the achievements of mineralogists and geochemists in Soviet Russia during the last five or six years, in which achievements Fersman himself has played a prominent part.

In its plans for economic development, the Government of the U.S.S.R. early realized the importance of utilizing the mineral resources of the State to the fullest possible extent, and ample provision was made for the investigation and development of these resources. Mineral survey parties, organized on scientific lines, directed their attention to promising areas, and were strengthened as required to carry forward the work of investigation.

One of the most productive of these exploratory parties was the one sent to the Khibin mountain area in the Kola Peninsula, within the Arctic Circle. Here, in an area occupied by nepheline syenites, extensive deposits of apatite were discovered, and as supplies of phosphate were required to meet the needs of Russian agriculture, steps to develop these deposits were taken without much delay in 1929. Within three or four years of the commencement of this undertaking, a carefully planned town had grown up around the apatite mines and quarries. The population of this town at present is about 40,000. The town has a central cinema seating 1,200 people, and has also a fine park.

Rivalling the remarkable mining enterprise at this locality, 2° within the Arctic Circle, is an equally remarkable agricultural enterprise, also

organized on scientific lines. Peat bogs have been cultivated, and by using nepheline and apatite powder as a fertilizer, forage grasses are being grown. One farm has a herd of a thousand cows, in addition to vegetable gardens. From the greenhouses of these gardens, the population is supplied with fresh cucumbers and tomatoes. It is hard to believe that life at this locality is free from inconveniences, but these do not enter into Fersman's account. Whatever these may be, the enterprise is indeed a remarkable one. With a present annual output of two million tons of mineral, and a prospective output of seven million tons in 1937, things look promising in this wonderful arctic town.

Among other discoveries and developments mentioned all too briefly in this book are those of the potash deposits of Solikamsk in the Urals, and many other deposits the exploitation of which promises to have important effects not only in the U.S.S.R., but also in the world at large.

The book deserved to be edited, printed and published in better style; but even as it is, and in spite of its somewhat extravagant appreciation of the part played by Russian workers in the development of geochemistry, it will be welcomed as a useful account of tendencies of thought and practice among these U.S.S.R. workers, who are much to be congratulated on the vigorous efforts they are making to establish a stronger scientific foundation than has hitherto existed for the study of minerals and mineral resources.

# Memoirs on Systematic Zoology

**Temminckia:**
a Journal of Systematic Zoology. Edited by Prof. Dr. H. Boschma. Vol. 1. Pp. v+320+9 plates. (Leiden: E. J. Brill, 1936.) 13.50 fl.

THIS new periodical is designed to afford a means of publication for memoirs on systematic zoology. It is named in honour of C. J. Temminck (1778–1858), one of the most distinguished naturalists that Holland has produced and the first director of the great Rijksmuseum van Natuurlijke Historie in Leyden. Its scientific standing is assured by the fact that the editor is the present director of the museum, Dr. H. Boschma, while the name of the publisher, E. J. Brill, is a guarantee of typographical and technical excellence. Unlike most journals of the kind, it will appear only in bound volumes, of which one or two, each of some 320 pages, will appear annually.

The first volume, besides many text-figures, includes nine plates, of which one is in colour. Of the seven memoirs published in it, five are in English and two in German. Four of the authors are Dutch, one German, one Austrian and one American. All the memoirs except one deal mainly with the fauna of the Dutch East Indies.

The first paper, by Dr. G. C. A. Junge, is a faunistic one, dealing with the birds of Simalur and some other islands off the south-west coast of Sumatra. It includes field notes by the collectors on habits and distribution of the species dealt with. C. J. Keijzer writes at length on "Variability in East Indian Foraminifera" and concludes that the supposed trimorphism and polymorphism of certain species have no real existence, but are due to superficial observation of continuous series of variations superimposed on the well-known dimorphism. It is to be gathered from the paper, however, that the life-cycle of the Foraminifera is not so simple or so well-understood as might be supposed from the usual text-book accounts of it.

A revision of the flying lizards of the genus *Draco* by Willi Hennig is based on examination of the material in many museums, gives statistical analyses of measurements, and discusses the geographical relations of the various "Formenkreise".

A paper on the use of the generic names *Tethys* and *Aplysia* among the Mollusca is surely the most fully documented discussion on a point of nomenclature ever published, the list of references at the end extending to more than eighteen pages. The author, Dr. H. Engel, makes out a strong case for submission to the International Commission on Zoological Nomenclature for suspension of the rules in order that the traditional use of these two names may be retained.

Dr. Koumans describes, with statistical data, evidence for an increase in the number of scales during growth in a species of fish. As the number of scales has hitherto been regarded as a constant specific character, this conclusion will have important results for systematists. In the concluding two papers of the volume, F. Spaeth revises the Australasian beetles of the group Cryptonychini, and Austin H. Clark describes the unstalked crinoids of the *Snellius* expedition.

Every systematist knows that it is comparatively easy to find editors willing to accept short papers describing a few new species. Every such

addition to the Systema Naturæ, however, demands some modification, although maybe very little, in the diagnoses of previously recognized species, and there comes a time when a revision of a whole group, a genus or a family, must be taken in hand if the system is not to fall into confusion. When an author is courageous enough to attempt such a revision for an extensive group, it is often hard to find a periodical in which it can be published, especially if it is to be adequately illustrated. It has not infrequently happened that such a revision has been laid aside for years after being completed in default of any means of giving it to the world. It is, therefore, a hopeful sign of reviving interest in systematic zoology that a journal should have been established in which important and lengthy memoirs of this kind may find a place.

W. T. CALMAN.

# Indeterminism and Psychology

**Déterminisme et variabilité dans le comportement des organismes**

(Exposés de biométrie et de statistique biologique, 7.) Par Prof. W. J. Crozier. (Actualités scientifiques et industrielles, 261.) Pp. 57. (Paris: Hermann et Cie., 1935.) 15 francs.

THE physicists have gone on strike against determinism and have called on the psychologists to come out in sympathy, but the psychologists can see no logical connexion between the physical problem and the psychological problem. It appears that the physicist can never know the facts about a single electron and can only predict the behaviour of aggregates. An individual animal represents a large aggregate of electrons and other units, and the fact that the behaviour of the individual units cannot be predicted does not necessarily imply that the behaviour of the aggregate is not governed by laws as rigid as those which govern the behaviour of a similar mass of inanimate matter. The difficulties of prediction appear to be due to the complexity of the problem rather than to any fundamental obstacle to observation. The psychologist is presented with a glut of facts about each individual and can see no reason why he should not explain the processes which govern individual behaviour, but such knowledge is likely to play a less important part in the world than a knowledge of the behaviour of aggregates of animals. Prof. Crozier, of Harvard, who has devoted the last ten years to the study of the behaviour of aggregates of rats, has published the summary of his results now under notice.

The evidence may be illustrated by describing a typical experiment. A rat is placed on an inclined plane in the dark, and its movements are recorded by photographing the movements of a patch of luminous paint on the rat's back. The rat knows that a suitable reward awaits it at the top of the inclined plane, and it therefore runs uphill in a series of short straight dashes. The angle between the movements of the rat and a horizontal line in the inclined plane ($\theta$) measures the accuracy of the rat's judgment, which must depend on sensations in the muscles of the rat's legs. When the results obtained from a large number of rats are averaged, their behaviour is found to be governed by laws. For example, the component of gravity in the direction of maximal slope will be proportional to sin $\alpha$. As the slope increases, the accuracy of the rat's judgment increases in such a way that, like other similar curves depending on sensation, the curve connecting $\theta$ and log sin $\alpha$ is shaped like a prolonged $S$, being approximately straight in the middle range.

The curve obtained from a homozygous colony of rats is constant and typical of that colony. If two colonies interbreed, the factors on which the position of the curve depends are inherited according to Mendelian laws. The variability of the animals was estimated by calculating the standard deviation of the observed values of $\theta$. Various conclusions are reached regarding the correlation between variability and slope. Different homozyous colonies of rats showed characteristic different degrees of variability, the inheritance of which has been studied.

Prof. Crozier discusses the philosophical implications of his results, which he considers to be opposed to the opinions of those physicists who would extend the principle of indeterminism to vital phenomena. On the other hand, he does not claim to be able to predict the behaviour of an individual rat any more than the physicist can predict the behaviour of an individual electron. He can, however, predict the behaviour of the average rat just as the physicist can predict the behaviour of the average electron. If methods such as those of Prof. Crozier can be extended to predict the behaviour of the average man, they may play an important part in deciding the destinies of nations.

**(1) La radiation cosmique**

Par P. M. S. Blackett. 1 : Aperçu général. Pp. 23 + 4 plates. 10 francs. 2 : La méthode de la chambre de C. T. R. Wilson (commandée par compteurs de Geiger-Müller). Pp. 25 + 3 plates. 8 francs. 3 : L'action du champ magnétique terrestre. Pp. 20 + 2 plates. 7 francs. 4 : La perte d'énergie par ionisation. Pp. 21 + 7 plates. 10 francs. (Actualités scientifiques et industrielles, 230–233.)

**(2) Rayons cosmiques**

Par B. Rossi. (Exposés de physique atomique expérimentale, 4 : Actualités scientifiques et industrielles, 248.) Pp. 48. 12 francs.

(Paris : Hermann et Cie., 1935.)

(1) THESE small books constitute the only connected account of cosmic rays which is available ; and although the lectures on which they were based were delivered two years ago, the account given largely represents existing knowledge, and the problems stated remain mostly unsolved. The first part contains a general and historical account ; the second deals with the technique and results of the counter-controlled Wilson chamber introduced by Prof. Blackett. This part contains the account of shower production. The third part is specially valuable. It provides a simplified treatment of the paths of electrified particles in the magnetic field of the earth, and the consequent effect of the field on the distribution of cosmic rays over the earth. The original papers in which this theory was developed by Størmer, Lemaître and Vallarta and others are difficult and in some cases inaccessible. The fourth part deals with the behaviour of very fast particles passing through matter. The details of the processes involved are still uncertain both in experiment and theory. They are at present the subject of intensive investigation, and some progress has been made, particularly in connexion with shower production.

(2) This brochure is more limited in scope than those by Prof. Blackett ; it is concerned very largely with Prof. Rossi's own experiments on the cosmic rays, by the coincidence counter method. The experiments include analyses of the rays by absorption and by azimuthal distribution, a study of the effect of the earth's magnetic field, and a study of shower production.

**Index Generalis**

Année 16, 1936. Annuaire général des Universités et des Grandes Écoles, Académies, Archives, Bibliothèques, Instituts scientifiques, Jardins botaniques et zoologiques, Musées, Observatoires, Sociétés savantes. Publié sous la direction de Dr. R. de Montessus de Ballore. Pp. vii + 2482. (Paris : Éditions Spes, 1936.) 225 francs.

THIS most recent edition of an extremely useful source of information concerning the universities, etc., of the world has the same format as its predecessors. All information has been obtained from official sources, thus marking the work as an authentic book of reference.

The first part of the volume gives details concerning the officers, professors and other teaching staff, laboratories and attached institutes of the universities of the world, though, unfortunately, those of the U.S.S.R. are again missing. This is through no fault of the editor of the "Index", who states that he has made repeated efforts to obtain the necessary information. This section occupies 1,213 pages of closely printed type. The next section, occupying 97 pages, supplies information concerning the personnel, publications, instruments, etc., of the astronomical observatories of the world. This is followed by 291 pages concerning libraries and archives. The next 139 pages deal with scientific institutes, such as museums, botanical and zoological gardens, biological laboratories, meteorological and other stations, etc. Societies and academies (with names of members of the more important) occupy the remainder of the text (190 pages). The general name index at the end contains about 95,000 names—a veritable mine for reference purposes ; there is also a general geographical index whereby it is easy to trace institutions.

We know of no other single volume publication which brings together in this way so much information regarding the learned world.

**The Kātkāris :**

a Sociological Study of an Aboriginal Tribe of the Bombay Presidency. By A. N. Weling. Pp. vii + 156 + 15 plates. (Bombay : The Bombay Book Depot, 1934.) n.p.

MR. WELING's sociological study of the Kātkāris, a criminal tribe of the Bombay Presidency, who survive in considerable numbers in the hilly districts of the Deccan, has appeared at an opportune moment. Not only has there been a tendency to confuse them with the Kunbi, from whom indeed it is not easy to differentiate them, but also, like other aboriginal tribes of India, their institutions are subject to influences which tend progressively in the direction of modification. This process is likely to be intensified rather than arrested among tribes, who still possess something of the hunting culture and of the animistic and magical beliefs, which are of an abiding interest for the anthropologist.

**Guide to Philosophy**

By C. E. M. Joad. Pp. 592. (London : Victor Gollancz, Ltd., 1936.) 6s. net.

THIS is one of the books which will help considerably the case of philosophy as a subject of fundamental interest and importance. It is held in many quarters that without some knowledge of philosophy, the education of a citizen is far from being complete. Those who oppose this view will no longer be able to point to the lack of reliable and interesting books on this subject ; for Mr. Joad provides them now with a practical answer in his "Guide to Philosophy". The subjects discussed in this lucid and attractive work are too numerous and too complex for even a brief review. It will suffice to say that the beginner and the specialist alike should derive both profit and enjoyment from its perusal. T. G.

# Revision of Ordnance Plans from Air Photographs

By Colonel H. L. Crosthwait, C.I.E.

IN the Interim Report of the Departmental Committee on the Ordnance Survey, discussed in NATURE of May 2, p. 719, reference is made to the employment of air photographs as a means of speeding up the revision of the 25-in. Ordnance plans. It is proposed in this article to indicate in general terms how this can be done.

The area it is proposed to revise is divided up into rectangular blocks of about 10 miles side. The aircraft, carrying a camera* which automatically exposes a roll of photographic film at prearranged intervals, is flown to follow a straight course over the ground, and parallel strips are photographed so as to cover the area as shown in the diagrammatic illustration (Fig. 1). For this particular purpose a lens of 20-in. focal length is employed, from a height of about 8,000 feet, giving a scale of approximately 1/5,000. These photographs are afterwards enlarged without rectification to a scale of 25-in. to the mile or 1/2,500. During the flight, the exposure of successive photographs of a strip is so timed that they overlap each other in a forward direction by about 60 per cent, and the strips are arranged to have a lateral overlap of about 25 per cent. If the work is skilfully carried out, the whole area should be covered by strips of photographs without leaving any gaps. The chief object, among others, of giving the photographs an overlap of 60 per cent, is that adjacent photographs of the same strip may be viewed in a stereoscope, which gives an impression of the ground in relief, greatly facilitating the interpretation of objects which might otherwise be doubtful.

It will be noticed that each object is photographed at least twice. Only in the case of level ground where the exposure has been made with the axis of the camera pointing vertically downwards, and where the lens used covers the film without distortion, will the resulting photograph give an accurate map representation of the ground as seen from the air. In practice, the two conditions of a vertical axis and level ground are scarcely ever realised, while lenses are now made practically free from distortion within the limits they are required to cover. It becomes necessary, therefore, to subject the photographs to some form of rectification in order to counteract the effect of camera tilt, which should be kept as small as possible, and the deviation from the level of the ground. This can be done in several ways, but since we are only dealing with the application of air photographs to the revision of the 25-in. plans, we need only mention the method used for this particular purpose. There are few instances where there is not sufficient control on the old plan, in the form of unaltered detail, which can be recognised both on the plan and on the photograph. It is this control which is made use of in the epidiascope. Space will

FIG. 1. Diagram illustrating how an aircraft covers the area to be photographed. By permission of Aerofilms, Ltd.

* The camera used is known as the "Eagle", made by The Williamson Manufacturing Co.

not admit of a full detailed description of the method or instrument, but we can indicate, in general terms, how the revision is carried out with the epidiascope.

The enlargement, derived from the negative taken from the air, which is, as stated, approximately on a scale of 25-in., is carefully examined with the old plan, and new detail is inked up in red. In doing this the draughtsman is aided by the stereoscope, in which has been placed the pair of overlapping photographs relevant to the area under revision. He then selects suitably placed and well-defined points of detail appearing both on the photograph and the old plan, to form triangles covering the area, later to be fitted to the plan in the epidiascope.

The ideal triangle for rectification would be one which embraced an area on a uniform slope proceeding from the base of the triangle. With this object, points selected should be sited, if possible, on high ground and at the bottom of valleys. For this purpose the 6-in. contoured map can be consulted, assisted by the relief view of the area in the stereoscope. The Ordnance Survey employs a modified form of epidiascope* in which the movements have been simplified. It consists of a horizontally placed photo-board over which has been inverted an ordinary camera the back of which forms the plan-board. The photo-board is capable of being tilted about a horizontal and vertical axis. To it the photograph can be secured in any desired position under a sheet of plate-glass on which the two axes are marked. The photograph is set so that the base of the triangle to be revised coincides with the horizontal axis, with its mid-point at the intersection of the two axes. An image of the highly illuminated photograph is formed on the matted surface of a sheet of drawing celluloid, on which has been printed, in grey, an impression of the old plan, placed on the glass camera back or plan-board. The image of the base of the triangle being revised is made to coincide with the corresponding base on the print of the old plan, any small difference of scale being adjusted by a slight movement of the camera lens. The photo-board is then tilted so as to make the triangles fit one to the other. The new detail, which has already been inked up on the photograph, is then drawn in on the celluloid print of the old plan. The same process is repeated, triangle by triangle, until the whole area has been revised. This drawing forms the 'field trace', but

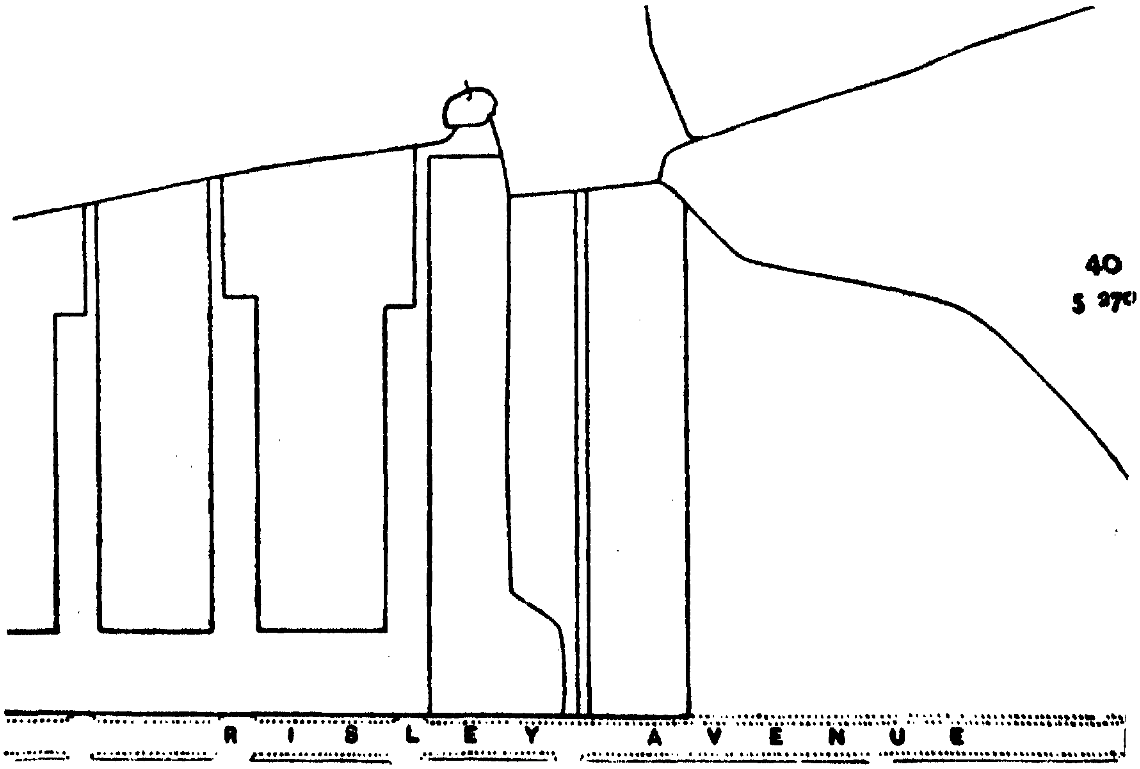


FIG. 2. Air survey of Tottenham. Reproduction of a section of a 25 in. Ordnance plan representing the area covered by the air photograph (Fig. 3). This plan was revised in 1913. Reproduced from the Ordnance Survey Map, with the sanction of the Controller of H.M. Stationery Office.

* For a full description of the epidiascope made by Messrs. Barr and Stroud, see "Surveying from Air Photographs", by Capt. M. Hotine, R.E.

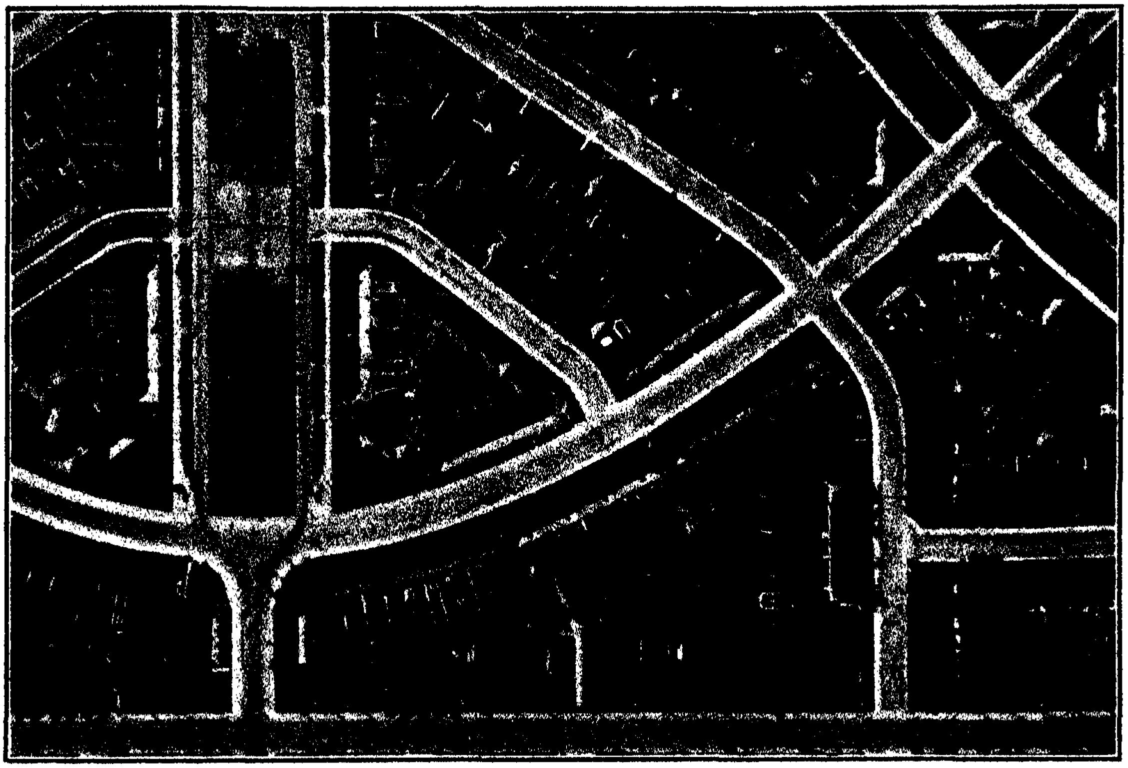

FIG. 3. Air survey of Tottenham. Vertical air photograph taken in June 1935 of same area as Fig. 2, scale 25 in. to a mile. By permission of Aerofilms, Ltd.

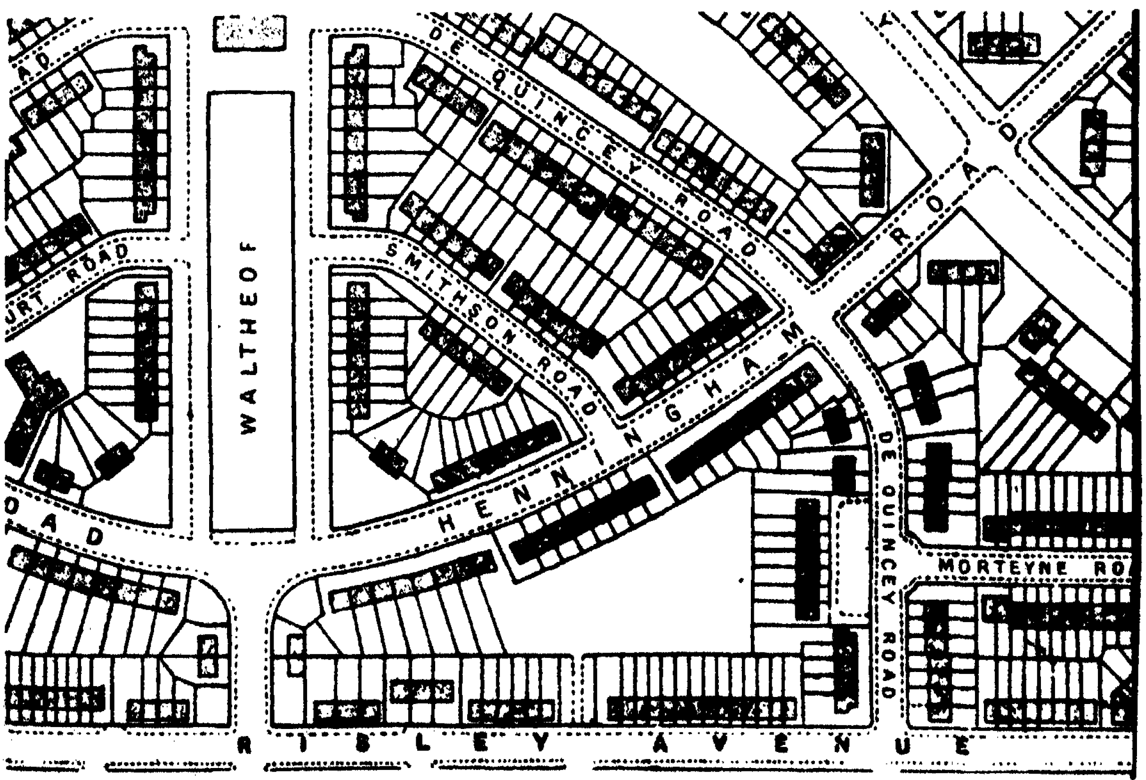


FIG. 4. Air survey of Tottenham. Resulting plan, scale 25 in. to the mile, plotted from photograph (Fig. 3). By permission of Aerofilms, Ltd.

since it is deficient in new names, boundaries and details such as wire fences, which fail to show up on the photograph, or which have been obscured by shadows, it is taken into the field for final revision. From it, when finally revised, the fair plan is drawn in the ordinary way. This, shortly described, without going into detail, is the process employed in revision from air photographs using the simplified epidiascope.

Owing to the small tilt of the photographs, which should not exceed some 2°, and the small area embraced by the triangles, the residual errors due to the theoretical inexactitude of the epidiascope design are so small as to be negligible. The advantage of the modified machine is that it is cheap to construct, a consideration of importance where a good many of them are required to deal expeditiously with a large number of photographs; also it is simple to operate.

Fig. 2 is a reproduction of a portion of an old plan; Fig. 3 a photograph of the same area as it now exists and Fig. 4 the resulting plan plotted from the air photograph.

# Archæological Discoveries at Předmost

THE site in Moravia known to archæologists as Předmost actually is, or was, a small hill to the west of the little village of Předmosti, which lies about two kilometres north of Přerov, a junction on the Central European line between Warsaw and Vienna. The hill rose to a height of forty metres above the marshy plain, and was known locally as "Hradisko" (oppidum), evidently having served the inhabitants as a place of refuge in time of war. The substructure of the hill consisted of two limestone rocks joined by a saddle of yellow brick-earth, or loess. The complete quarrying away of one of these rocks many years ago has exposed the face of the loess, and at the base level of the rock in a band of darker deposit have been found relics of prehistoric man in such a quantity and of such a character as to justify the verdict that this is one of the most important palæolithic sites ever discovered.

The former inhabitants had evidently used the rock as an *abri*, or shelter, and had lived by hunting, mainly of the mammoth. Relics of this animal are almost innumerable. A thousand teeth and five milk-teeth have been found, and of the tusks, complete or broken, there are some hundreds. In the first series of explorations of the site, no less than twenty thousand implements of stone, bone and ivory were collected, while the carvings and engravings of ivory and bone are æsthetically and culturally of great interest and importance. The outstanding feature in the discoveries which have been made, however, is an assemblage of the skeletal remains of early man, in which twenty individuals were represented in a single find. The ethnic character of these individuals is no less interesting than the conditions in which they were found.

The first recorded discovery at Předmost was made so long ago as 1571, when "giants' bones" were discovered by John Blahoslav; but it was first recognised as a palæolithic station by Dr. J. Wankel in 1880 and 1881 as the result of an investigation which had begun in 1878. The great explorer of Předmost, however, was K. J. Maska, a schoolmaster, who first turned his attention to the site in 1882, and excavated it systematically and continuously in the ten years 1884–94. It was in this last year that he made his sensational discovery of human remains, when, as already mentioned, skeletons and parts of skeletons representing twenty individuals were found in a small space, an elliptical grave, measuring 4 metres long by 2·5 metres wide by 30 cm. deep. These remains were closely packed, side by side and one upon another, in a crouched position, the heads in most instances towards the north. They lay in the loess above undisturbed quaternary deposits, but separated from them by a calcareous layer 30–50 cm. in thickness. Above the skeletons was the complete skull of an Arctic fox, at the north-west edge was a fragment of the shoulder-blade of a mammoth, which had been graven by a flint tool, and at the south-west lay a complete mammoth shoulder-blade. Two lower jaws of the mammoth, found two metres away, may be related to the burial. Other finds adjacent were fragments of flint and jasper and carbonized bones. Stones to a thickness of 40 cm. had been piled above the interment. Nevertheless, gnawed human bones nearby, and the incomplete condition of some of the remains, suggest that these stones had not availed to keep away beasts of prey.

Unfortunately, no photographic record or drawing was made of the find; and discrepancies in detail have gained currency in accounts of the discovery. The finds associated with the skeletal remains and their position mentioned above are those recorded by Dr. J. Matiegka, to whom Maskra's material was entrusted.

This interment is evidently a communal grave, though whether it was the result of an epidemic or some other simultaneous catastrophe, or represents a succession of burials, thus accounting for the evident disturbance of the remains, there is nothing to show. There are sufficient close resemblances between individuals, some of them inherited, to warrant the conclusion that, if not all of one family as Maska thought, they were at least members of a single familial horde.

Maska's work was followed up by M. Kříž, a lawyer, who carried out excavations in 1894–96. The great collections formed by these two investigators have now been placed, with other valuable archæological and palæontological material brought together from different parts of the country, in the Provincial Museum of Moravia at Brno, where they are in the care of Prof. D. K. Absolon, curator of the Quaternary Collections.

Maska spent the remainder of his life at work on his material from Předmost; but his financial circumstances did not permit him to devote to it the time and attention it demanded. He died while his work was still incomplete in 1916, and Kříž died in the same year.

After the Great War, the interest aroused by the discoveries of early man in Moravia, evidently a 'gate of entry' for early migration into Central Europe, led to more systematic study. Chance favoured the resumption of investigation at Předmost. Further commercial exploitation of the remains of the hill for brick-making purposes opened up the loess deposits by trenches. Important discoveries followed and the Government intervened, taking over the site and entrusting its further investigation to Prof. Absolon, whose discoveries date from 1924.

With the aid of later investigation, it is now possible to obtain a truer perspective of the whole site. The occupation level appears as a darker horizontal band in the yellow clay at a depth of one to four metres and 20–70 cm. in thickness, its extent being estimated at 6,700–10,000 cubic metres. There are three main centres of accumulation, of which one is a domestic hearth with broken bones and implements of stone, the second a hearth of greater extent, which may have served for the preparation of food, with larger bones and finer implements, and a third of indeterminate purpose, consisting of a quantity of varied débris, without order and including bones of every kind, among them whole quarters, such as mammoth's feet, part of the backbone of a horse, etc. Some, however, show signs of arrangement, as for example a pile of thirteen mammoth tusks and four skulls placed side by side.

The vast wealth of objects which now form the collections from Předmost—implements of stone, bone and ivory, carvings and engravings on ivory and bone, personal ornaments of various materials and the like, the human skeletal remains, as well as the remains of the mammoth and other quaternary fauna—reveal the mode of life of the primitive hunter in quaternary Europe in a manner and to an extent which cannot be equalled on any other site, though with it is comparable the site of the horse hunters of Solutré. The development of its art is especially noteworthy. Certain objects, especially a remarkable figure of a mammoth in ivory, are characterized by a naturalism, comparable with the best produced by palæolithic man elsewhere. Here also are the characteristic corpulent figures, woman or divinity. In striking contrast is the work of another 'school', a school with a marked tendency to conventionalize, which culminates in a female figure engraved on a tusk, in lines which are entirely geometrical. It has been suggested that the two schools represent the influence of two distinct races, which met at this point.

The racial characters and affinities of Předmost man have been the subject of considerable discussion; but as such analyses have been based upon photographs and casts, certain features have been stressed unduly, and an authoritative and first-hand account of the remains has long been desired. Whereas many of the authorities concur in showing a tendency to attach too great a significance to the resemblances between Předmost man and Neanderthal man, it stands to the credit of Sir Arthur Keith's acumen and appreciation of the essential quality of the remains, that while recognizing the importance of the great size of the skull and the massive character of the attachments for the muscles, he has been emphatic in claiming an essentially 'modern' character for Předmost man; and further, while pointing out the marked difference between the sexes, he has not been prepared to go so far as those who hold that it is sufficient to justify the allocation of the woman to a different racial category.

The skeletal material available for discussion of the racial character of the people of Předmost, of which the crania, some represented by fragments only, have now been described, and their evidence analyzed, for the first time by Dr. J. Matiegka*, whose paper has only just recently become available, is regarded as representing twenty-six individuals. To this must be added a further discovery by Prof. Absolon in 1929. Of the material found by Maska, fifteen skeletons were fairly complete, while the remaining material was judged to belong to five individuals. Of the fifteen four were, comparatively speaking, well preserved. Eight of the twenty

* Česká Akademie Věd a Umění (Académie Techèque des Sciences et des Arts). Trída 2: Anthropologica. Homo Předmostensis fosilní člověk z Předmostí na Moravě. 1: Lebky. (L'Homme fossile de Předmostí en Moravie. 1: Les crânes.) By Prof. Dr. J. Matiegka. Pp. 145+16 plates. (Praha: Česka Akademie Věd a Umění, 1934.)

were adult, three being female, two adolescent, one male and one female, seven were children less than ten years of age, and three were infants of under one year.

Of the adults, the two best preserved were a male and female between the ages of thirty-five and forty years. They are regarded as type specimens of the race. The two well-preserved adolescents approximate closely to them, due allowance being made for the difference in age. The adult male, in particular, shows the close resemblance to Neanderthal man in a number of characters, notably the prominent supraorbital ridge, or torus, the low retreating frontal bone, and so forth. Indeed in its approach to early palæolithic man, this skull, Dr. Matiegka points out, is very near the border-line of the extreme lower range of 'modern' skulls. On the other hand, in certain features, such as for example the possession of a well-marked, if not prominent chin, and the absence of the characteristic prognathism, it is essentially modern.

All the individuals represented at Předmost, with one exception, are sufficiently homogeneous to be regarded as belonging to a single race. Dr. Matiegka stresses in particular their slender character, seen also in the long bones, their light weight, and in the bones of the skull their thinness, features in which they are distinguished from man of the earlier palæolithic period, and to be viewed in relation to size and capacity. In virtue of pronounced Neanderthaloid characters, Předmost man may be regarded as standing morphologically midway between Neanderthal man and modern man, but not in any genetic sense.

In all its dimensions the Předmost skull, both male and female, is within or well above the average of the modern European. The head length ranges from 189 mm. to 201 mm. male, and 185 mm. to 191·5 mm. female; breadth 139 mm. to 145 mm.; height 133–136 mm. In relation to the great size of the skull, the figure for height appears low, but actually it is above the modern average. The cephalic index varies from 70·15 to 77·63, being slightly higher in the women and children than in the men. The contour is ovoid. The cranial capacity is high, 1,578 c.c. male, 1,520 c.c. female, as against 1,475 c.c. male and 1,300 c.c. female in the modern European.

The development of the supraorbital ridge, assuming in certain skulls the character of a torus, appears also in the women and is even perceptible in the children. The sutures are simple; but in all the skulls there are Wormian bones.

The face is high, especially in the upper part, lower in the woman than in the man. The orbits are low, quadrangular and set slightly on the bias in both sexes. The nose is narrow and prominent in the men, broader in the women. The lower jaw is large, corresponding with the size of the skull, but notwithstanding its massive appearance, largely due to the disproportionate strength of the muscular attachments, it is slender in proportion to its size. The chin is slightly receding in relation to the alveolar projection, but there is a well-formed mental tubercle. The form of the jaw is modified by muscular pull. The teeth are well preserved. They are large. There is one apparent case of caries. At least two skulls have lost teeth during lifetime. The teeth are much worn down, the wear already beginning to appear in a boy of ten to twelve years. There is also evidence of a peculiar form of attrition of which the cause is obscure. It is more marked on the right side than on the left, and on that side in the upper jaw more than in the lower. It affects the first molar, the second showing it, if at all, only in a slight degree. It has been suggested that this is due to a custom of carrying a pebble in the mouth continuously, though for what reason is not apparent. In view of the cold climate and its continuous use, it could scarcely be for the purpose of alleviating thirst.

In considering the affinities of the crania of Předmost man with those of other forms of Quaternary man, too much importance must not be attached to the resemblances to Neanderthal man, which have been noted in the first-named. They do not warrant the conclusion at which some anthropologists have arrived that Předmost man represents the stage of transition in a series which extends from Neanderthal to modern man; nor are they the results of a cross between Neanderthal and Aurignacian man. They are due, it must now be held, to simple convergence.

Of the types of 'modern' man of Quaternary age to which the Předmost crania may be related, Grimaldi and Chancelade may be ruled out, notwithstanding affinities to the latter, which have been noted. Předmost stands with Brno I and Brno II, distinct from, but closely related to Oberkassel, with the female Oberkassel as a transitional form. In general terms, it is a simple variant of the Cro Magnon race.

This interpretation of the skeletal evidence is in sufficiently close agreement with the geological and archæological evidence. The fauna of the loess beds points to a rather cold climate of tundra type; while the culture of the settlement, which Maska thought to be Solutrean, is now regarded as developed Aurignacian, the Abbé Breuil would hold with strong Solutrean influence from Hungary, but which Prof. Absolon considers entirely Aurignacian, though of later date than Vistonice, the Moravian station which corresponds to the Upper Aurignacian of France.

# News and Views

### Native Policy in Africa

A MOTION by Mr. de Rothschild in Committee of the House of Commons on July 9 to reduce the Colonial Office vote initiated a debate on colonial administration with special reference to East Africa, and afforded Mr. Ormsby-Gore as Secretary of State for the Colonies an opportunity of making an important statement in reply, in which he touched upon a number of matters affecting native interests. As an earnest of a promised expansion in education when resources permit, he referred to the provision forthwith of a central institution in Uganda, which would extend facilities for higher education throughout East Africa. He also showed that he is fully aware of the necessity for considering the possibility of regulating the movements of emigrant labourers, to which attention has been directed recently, more especially by conditions in Nyasaland (see NATURE, June 6, p. 921). His most important pronouncement, however, was concerned with the difficult and controversial question of the allocation of land as between native and settler in Kenya. He announced that two orders arising out of the Morris-Carter Report are in contemplation. By one of these orders, some 48,000 square miles of territory will be reserved to the natives, this including the most thickly populated areas, in which 86 per cent of the natives are living; while in the second order, 16,000 square miles of the highland area will be assigned to non-natives, one quarter, however, being set aside for a permanent forest reserve. Before these become effective, however, Mr. Ormsby-Gore indicated that it would be necessary to deal with the question of the 'squatters', upon which he confessed frankly that he had not made up his mind. There are now, he pointed out, 150,000 natives in Kenya living on European farms under annual agreement. These hold from the farmer a house and land in return for 180 days labour per annum at a contract rate of pay. There are also other natives in the European area who are not squatters, but in course of time have acquired rights. Some of these have been dealt with already in accordance with the recommendation of the Morris-Carter report, and removed to an agreed location.

THE problem of the squatter is, indeed, difficult. Mr. Ormsby-Gore's dilemma, as he showed, is whether to permit a system to endure, which while it assures a certain amount of labour to the farmer, is open to abuse, as experience has shown, on both sides, or whether to require labour to be obtained from the reserves in conditions which would keep the native in touch with tribal institutions and discipline. In South Africa, where the squatting system has a long history, it is proposed under the new regulations for native lands that it should not further be permitted; while scientific study of native institutions and the effects of the impact of white civilization on native life and morale would favour the stricter regulation of conditions of employment and intercourse, which the restriction of labour to natives from the reserves would make possible. The present mobility of labour in Africa, as recent events have shown, makes it eminently desirable that there should be some uniformity in native policy; and this is, no doubt, one of the considerations which the statesmen of the Union of South Africa have in mind in their expressions of opposition to any interference with present conditions in the mandated territories of South-West Africa and Tanganyika. It was certainly contemplated by Mr. Pirow, the South African Minister of Defence, when, at Nairobi on his way back to South Africa (*The Times*, July 10), he urged the importance of a common policy for native affairs, defence and customs, in the three groups into which he classified British Africa, from Kenya to the Union. A further important step in this direction is also to be noted in the amendments to the constitution of Southern Rhodesia. According to the draft regulations in the White Paper (Cmd. 6218), issued on July 9, the native reserv [illegible] in a Board of Trustees, a [illegible] Department with a Chief Native Commissioner at its head who "in view of his very important responsibilities, may not be removed without the Secretary of State's consent".

### Proposed Tribute to Prof. A. L. Bowley

IT is intended to mark the retirement of Prof. A. L. Bowley from the chair of statistics in the University of London by a recognition in some degree commensurate with his distinguished services. Prof. Bowley has not only given to the London School of Economics, since its beginnings in 1895, years of brilliant and devoted teaching; he has at the same time made contributions to social welfare that have been recognized throughout the world, by universities, by learned societies and by Governments. His published writings have given him an eminence all his own, and his kindliness and geniality have endeared him to generations of students and to all who have had the good fortune to work with him. Over the signatures of Lord Kennet, Mr. J. M. Keynes, Prof. D. H. Macgregor, Prof. W. R. Scott and Sir Josiah Stamp, an appeal has been issued, since it is felt that past students and many others will welcome an opportunity to share in an expression of admiration for the work he has done. It is proposed that this tribute of esteem shall include a portrait of Prof. Bowley to be hung in the London School of Economics, and a scholarship or prize tenable in the University of London (at the London School of Economics) to assist a student pursuing undergraduate or postgraduate study in economic or social statistics. Sir William Beveridge has agreed

to act as treasurer of the fund, and all subscriptions should be addressed to him at the London School of Economics, Houghton Street, Aldwych, W.C.2, England.

### Anglo-German Stork Experiments

THE present experiments on the migration of the stork (*Ciconia alba*) being carried out in England in conjunction with German ornithologists is evidence of the wider possibilities of international co-operation in field ornithology than have hitherto obtained. Earlier in the spring, eleven storks' eggs from German nests were sent to England and placed in heron nests in Surrey by the Haselmere Educational Museum, as the stork is no longer a British nester, and it was hoped the experiment would indicate whether or not the English-born birds under heron foster-parents would follow the same migration route as German birds. However, only one egg hatched, and after a week the stork chick was accidentally crushed to death by the foster parent. It is hoped to repeat this experiment next spring. In June, a further experiment was made when twenty-three nestling storks from East Prussia were distributed to artificial nests in Scotland, Kent and Surrey where they were hand-fed, and it is hoped that if reared, these birds, which are ringed, will shed further light on migration, and how far inheritance plays a part in it.

MUCH work on the migration of storks has been carried out on the Continent in recent years. The early experiments at bird-ringing were made by Brugmann in Holland and Mortensen in Denmark last century with storks (NATURE, Sept. 30, 1933), and later research showed that birds nesting east of the River Elbe used an Asia Minor route to the Natal winter quarters and those nesting west of the river a route through Spain and Morocco. Three years ago, young storks born east of the Elbe were ringed and released west of the river, but soon found their way back. The small percentage of stork rings recovered in Africa has lately been shown to be due to the Egyptian natives treasuring them as tokens for fertility, a barren woman who obtained one having worn it and given birth to children, and hence the superstition spread. Skougaarde has reported a stork ringed in Jutland and believed to have lived between thirty and forty years.

### Hadrian's Wall

EXCAVATION of the fort on the Roman Wall at Halton Chesters, near Newcastle-on-Tyne, by the University of Durham Excavation Committee, has made it possible to state definitely for the first time that the building of the wall was completed within a period of five years. A dedicatory tablet on the west gate of the fort has been found, it is stated in a report of the Committee (*The Times*, July 13), which bears the name of Platorius Nepos, the Governor of Britain in A.D. 122–126. As he also directed the first stages of building, the whole erection was completed within his term of office. The excavation has thrown much light not only on the methods of planning and construction of the fort but also on that of the wall itself. It is evident that the original plan was not always followed. For example, the original ditch fronting the wall runs straight through below the existing fort, one of six, which projects 200 ft. north of the wall. The east and west gates of the fort are carried down the entire depth of the filled-in ditch and are built on massive foundations. There is evidence of two considerable reconstructions or enlargements. After the Caledonian invasion, the Emperor Severus rebuilt the fort in about the year A.D. 205, erecting a monumental fore-hall in front of the administrative building. No hall so fine as this, it is stated, has as yet been discovered in Britain, where, in any event, they are rare. It is shown by the foundations to have been 160 ft. long by 30 ft. broad, with a central entrance spanning the north-to-south street. About a century later the fort was increased in size by an enlargement towards the west behind the shelter of the wall. This structure gave the fort the peculiar L-shaped plan which has long been a puzzle to archæologists.

### Meteorology for Airmen in India

A COPY has been received of a new publication of the India Meteorological Department (M.O.A. Pamphlet 1936) entitled "Meteorological Organisation for Airmen". The purpose of this pamphlet is made clear in the introductory pages by the Director-General of Observatories, where the relevant part of the organization of the Department is described, together with the procedure to be adopted to obtain weather reports for the different parts of the area with which the Department is concerned; this area extends from the south-eastern half of the Persian Gulf across the whole of Baluchistan, India and Burma. It is admitted that the existing organization for the supply of weather reports and forecasts for such a vast area falls short of the standards recommended by the International Convention for Air Navigation, particularly in the south of India, the reason being the size of the area in relation to the permitted financial expenditure on the organization, which is less than what it was formerly in spite of the increased demands of aviation, a fact that has necessitated various reductions, including the closing down of the important forecasting office at Quetta.

THE different areas covered by the forecasting centres in India are shown on a key map, which indicates also the centres themselves, the different airship bases, the pilot balloon stations from which information about the winds of the upper atmosphere can be obtained, and the aeronautical wireless stations. More precise information about these centres is given in extensive tables, which, together with further tables giving the various weather codes in use in India, occupy the greater part of the fifty-one pages of the pamphlet. Information of the kind provided is of course practically essential to airmen flying in a part of the world subject to very violent disturbances, ranging from tropical hurricanes to duststorms and tornados and other local

phenomena that render aerial navigation dangerous to all classes of aircraft. A form is included, as a detachable page of the pamphlet, to be forwarded to the Director-General by anyone wishing to receive, free of charge, copies of all supplements and new editions as they are issued to cover the inevitable changes and growth of this meteorological service.

### Yugoslav Cultural Progress

LITTLE notice is apt to be taken of the quiet constructive work or scientific developments that go on among the smaller nations. With this fact before it, the Society for Promoting Anglo-Saxon Culture in Yugoslavia has commenced the publication of an *Anglo-Yugoslav Review*, a quarterly to be devoted to the furtherance of the use of English among Yugoslavs and also to acquaint the British and American peoples with the educational, cultural and general progress of the South Slav nation. Its appearance coincides with the celebrations arranged for the eightieth birthday of Nicholas Tesla (born on July 10, 1856), which were held at the end of May. Tesla is a Yugoslav by birth, although most of his work and electrical discoveries on alternating and high-frequency currents were made at Paris and in America. A 15,000 horse-power plant of Tesla's conception was erected at Niagara in 1891 to supply power to Buffalo, 25 miles away—a remarkable feat at the time. Indeed, Tesla's fellow-countrymen claim that his work ranks him on a level with Volta, Watt and Faraday. Approximately half the review is devoted to the section on science and invention. Other sections deal with political, economic, sociological and miscellaneous matters, and among these is an account of recent archæological discoveries in Yugoslavia. Among the four British or American contributions is one by Mr. C. H. White, who discusses the cultural consequences when a nation's mineral resources are developed. The review is published in Belgrade, price 10*s*. per annum.

### Transmission and Distribution of Electricity

IN a progress report by C. F. Bolton and R. H. Abell on the transmission and distribution of electricity (*J. Inst. Elec. Eng.*, April) there are several points of special interest. The British Grid uses a pressure of 132 kilovolts, but there is a large number of systems operating at 220 kv. in different parts of the world. In Sweden a hydro-electric power station operates over 200 miles at 220 kv. In France there is a line at this pressure which brings hydro-electric power to Paris. Great activity has been shown in electric development in Russia, and the Dnieper system operates at the same pressure. The Boulder Dam project on the Colorado River represents one of the outstanding engineering achievements of recent years. A part of the energy developed, 1·3 million kilowatts, will be transmitted 266 miles to Los Angeles by a 287·5 kv. transmission line. German engineers have constructed several of their 220 kv. lines so that they can be converted ultimately to work at 380 kv. A scheme using a transmission voltage of 400 kv. has been proposed for the establishment of a large water-power station in Norway for supplying power to Sweden, Denmark and Germany. The main transmission system is to be some 650 miles in length. It terminates at Hamburg, and will have intermediate stations at Göteborg and Copenhagen. The generating plant will have a capacity of nearly a million kilowatts (1·34 million horse-power). The British Grid scheme is now completed, and through it, the considerable water-power sources now available in Scotland are being exploited. The problem of 'system stability' arises when large blocks of power are transmitted over long distances. In Great Britain it is not of special significance.

### Care of Old Trees

THE general public probably expresses more sentiment upon the beauty of large trees than upon any other aspect of horticulture. Yew trees may, under good conditions, live to the ripe age of a thousand years, and the oak can boast of very considerable longevity. Whilst the life of a tree must sometime come to an end, the artificial conditions of urban England often shorten its span, unless special care be taken. Mr. A. D. C. Le Sueur has recently shown (*J. Roy. Hort. Soc.*, 61, Pt. 4, 149–159, April 1936) what steps may safely be taken to check decay. Wounds should be cut to healthy wood, treated with a light creosote fungicide, and then rendered waterproof with bitumen. Branches should be cut close to the trunk. Cavity wounds usually contain wood already decayed, and should be cleaned drastically before filling with bitumen or concrete. Artificial support may be given with cables or rods, rather than by bands. Faulty soil conditions, such as lack of nutrients, water or air, or bad drainage, frequently retard good tree growth in public parks. The paper gives many details for the treatment of such backward trees, and provides innumerable instances of scientific practice of the greatest interest.

### Earthquake Records at De Bilt, Holland

TWENTY-ONE years ago, the first number of the *Seismische Registrierungen in De Bilt* appeared under the editorship of Dr. E. van Everdingen. We have recently received the annual report No. 21 for the year 1933, still issued under the same capable direction. The seismological observatory of De Bilt lies about five miles north-east of Utrecht. In 1904, it contained a pair of Rebeur-Paschwitz pendulums and a Wiechert horizontal seismograph, and, in 1912, a pair of Galitzin horizontal seismographs were installed. In 1933, the same instruments were in action with the addition of a Galitzin vertical seismograph. The bulletin for 1933 contains the records of 450 earthquakes, and it is worthy of notice that, besides the usual details with regard to the times of the principal phases at De Bilt and the estimated positions of the epicentre, the editor should have been able to collect notices of nearly one-third of these earthquakes from the countries in which they were felt.

## A Bibliography of Wheat

A BIBLIOGRAPHY of world literature on the genetics and breeding of wheat has been issued by the Institute of Plant Industry, U.S.S.R., and forms the first volume of a new series of publications on wheat (*Bull. App. Bot., Genet. and Plant Breeding*, Series VA, No. 1, pp. 136; 1935). In this work, the titles of articles or books appear in the language of the original contributions, and, where these have been reviewed, reference to the reviewing journal is given. The material is classified under various headings and, within each class, is arranged chronologically. An author index is included.

## School Nature Study

THE July number of *School Nature Study* (31, No. 124), the official organ of the School Nature Study Union, contains several articles of interest. An ecological study of the plant life of the salt marshlands of south-west Sussex by A. D. French reveals four important zones, namely, the inner shore banks above high-water mark, beaches and sands above high-water mark, the interzonal region, and the marsh proper. The vegetation of these zones has been carefully examined and recorded. The animal life, too, afforded certain features of interest, and a list of birds is given. The birds of Costa Brava, Spain, have been studied by Margaret M. Hutchinson, and her observations are embodied in a short article (together with a list) in the same number. A. C. Evans, of the Rothamsted Experimental Station, contributes an article on insects and their food. The factors determining an insect's choice of plant food are examined, and the author reveals our great lack of knowledge on this problem, especially from the point of view of plants of economic value. The School Nature Study Union publishes a series of pamphlets dealing with subjects of interest to the biologist, about seventy of which are reprints from *School Nature Study*; five other Special Leaflets are also available. A list of the pamphlets may be obtained from Mr. E. G. Clarke, 7 Stanley Avenue, Wembley, Middlesex.

## Library of Conchology

MR. SOHTSU G. KING, the Chinese conchologist and banker, has recently given his valuable collection on conchological literature to the Science Society of China Library, Shanghai. The collection was started some twenty years ago, while he was studying Chinese Mollusca with Prof. A. W. Grabau of the University of Peking. Under their joint authorship, a book entitled "Shells of Peitaiho" was published and is now in its second edition, besides many other scientific papers. The collection consists of many valuable and rare works and several complete sets of journals. It is no exaggeration to say that the collection is unique in the Far East and invaluable to students of zoology in general and conchology in particular. The Council of the Society has passed a resolution that a special room shall be used to house the collection and shall be labelled, "Sohtsu G. King Library of Conchology". The books have already been arranged, and a complete catalogue is in preparation and will be printed and circulated to research institutions and learned societies interested. In addition to the collection, Mr. King has also given an endowment, the income of which is to be used to provide the collection with the necessary periodical literature.

## Records of the American Mercantile Marine

A CO-OPERATIVE project has just been launched by the Smithsonian Institution and the Works Progress Administration of the United States, having the two objects of preserving a set of standard measured drawings of American types of fishing vessels and merchant vessels, to be placed in the Watercraft Collection of the United States National Museum, and of providing work for unemployed naval architects, draughtsmen and boat builders. The work is to be known as the Historic American Merchant Marine Survey, and the information is to be gleaned from builder's models, original drawings and the actual vessels. It is to be hoped these efforts will lead to similar projects elsewhere.

## London Health Services

THE Annual Report of the Ministry of Health for the year 1934–35 contains a special detailed review of the public health work carried out in London by the London County Council, the City Corporation and the Metropolitan Borough Councils. In view of the general interest of this review, it has now been issued as a separate publication, with a preface by Sir Kingsley Wood, the Minister of Health ("London Health Services". London: H.M. Stationery Office. 1*s*. net). The publication gives a useful survey of the division of functions among the various sanitary authorities in London, and describes the public health and poor law medical services, the food protection services, port sanitary administration, and welfare of the blind.

## Rubber Latex

A REVISED edition of the book "Rubber Latex" by H. P. and W. H. Stevens has just been published by the Rubber Growers' Association, 19 Fenchurch Street, London, E.C.3, and a copy will be sent to any reader interested, on application. It deals in 224 pages with the properties, composition, coagulation, concentration, manipulation and compounding of latex and latex pastes, the vulcanisation of latex and latex products, and dipping and electro-deposition. The final chapter deals with a selected list of nearly a thousand recent British patents, and indicates the growing importance attached to the direct application of latex.

## 'Loose-Leaf Binders' for NATURE

MESSRS. EASIBIND, LTD., Pilot House, Mallow Street, London, E.C.1, have sent us a specimen 'binder' made to take twenty-six issues of NATURE, without advertisements. The first and last numbers are held by stout wires passing through the centre pages of the issues, and intermediate copies are carried on thin wires which go alternately into one of two parallel slots in a metal fitting at the top and bottom of the back of the 'binder'. By this device

(*Continued on p.* 119.)

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SUPPLEMENT

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## Direction Finding by Sound*

By Dr. W. S. Tucker, O.B.E., Director of Acoustical Research,
Air Defence Experimental Establishment

IT is a regrettable fact that some of our scientific activities have required the stimulus of war to initiate them and the fear of war to keep them alive. Not the least striking example of this impingement of military necessity on scientific research is afforded by the subject of direction finding by sound. During the Great War, sound provided the only means of locating the submarine that threatened our shipping, mining operations that threatened our entrenchments, the distant and invisible gun and the aeroplane flying behind cloud or in the darkness; and this search by sound provided four widely differing methods all requiring advanced scientific technique. The subject is so large that I am proposing to confine myself to the operation of finding the direction of sound transmitted through the air.

It is curious that, of air-borne sound, the War provided us with ideal sources—the gun and the aeroplane. The gun report is an almost perfect example of an impulsive sound—the anti-aircraft shell burst is even better. The aeroplane, so complex in the nature of its sound, has something so rich in its elements—high frequency, low frequency, impulsive, musical, non-musical—that it gives a fascinating mixture of qualities taxing the provision of many kinds of apparatus for investigating its properties.

The fear engendered by these characteristic sources—gun and aeroplane—has stimulated lines of scientific inquiry almost entirely dominated by military requirements, and such inquiries and the results of them have fallen into the category of secret investigations with all the handicaps of fettered scientific discussion. I will try, however, to strip my subject as much as possible of its war implications, and endeavour to show how fascinating the study of sound direction finding can become.

All living creatures equipped with listening faculties appear to have a capacity for obtaining the direction of sound, but this sense of direction is only provided by the functioning of two ears. When either a human being or an animal is deprived of hearing in one ear, sense of direction is very seriously impaired. What is called the binaural faculty has to be replaced by that of a single ear, in which reliance must be placed on variations of intensity due to the shadowing of the head. Even so small a creature as the cricket, using two ears, shows good directional perception, as has been shown by the direct flight of the female to the chirping male, and it has been shown that removal of the tympanum of one ear of the female deprives it of this capacity[1]. Some interesting experiments of Engelmann[2], working in the laboratories of Prof. D. Katz, illustrate the performance of a very intelligent sheepdog called "Asti", one of whose ears was bandaged. The dog then lost its remarkable powers of direction finding. Some residual sound in the bandaged ear appeared to give partial help, but, in addition to exhibiting false judgments, the dog's reaction time changed from about $\frac{3}{4}$ second to a mean of nearly 4 seconds.

What, then, is the function of the second ear? The answer appears to be perfectly easy when the

* From the Friday evening discourse at the Royal Institution delivered on May 1. The author wishes to acknowledge with thanks his indebtedness to the Royal Engineer Board of the War Office for permission to refer to matters of military interest.

sounds to be located are impulsive or of short duration. The ears owe their directive capacity to the fact that they are separated, and the distance between them is a determining factor. If the sound is directly in front, the sound arrives at the two ears simultaneously; if from the side, one ear receives the sound a very short time earlier than the other, the measure of that time being determined by the angle that direction makes with the median plane of the head, or with the line perpendicular to that joining the ears. From the known speed of travel of sound and the distance between the two ears, a time interval can be worked out for every direction, so that, if the brain recognises this time interval, a definite direction can be associated with it. A more accurate appreciation of direction can be given by turning the head until we face the sound, and this corresponds to the simultaneous arrival of the sound at the two ears. This time difference theory, enunciated by Hornbostel[3], has been supported by most modern exponents, and has been shown to be not inconsistent with the late Lord Rayleigh's theory of location by phase difference.

A very good example of direction finding by measuring time intervals is shown in sound ranging of guns[4]. Here the ears are replaced by microphones. Instead of the base length of only about 6 inches for the two human ears, the microphones were at the ends of a base from half-a-mile to three-quarters-of-a-mile long. The time intervals were therefore long and measurable by suitable timing apparatus, and from these any two microphones gave a direction, three gave two directions and an intersection, and therefore a location. Three more microphones were used in an installation, in the War, making six in all, giving five directions and a mean of locations which improved the accuracy of location very considerably.

The unit of measurable time difference was then about 1/100 sec., and recent advances in sound ranging have made it possible to measure to less than 1/1000 sec.; but the human mechanism of time recording is very much finer than this. Thus, experiments have shown that the pair of human ears with the interpretation of the brain can distinguish time intervals of 30/1,000,000 sec., and interpret them into a perceptible difference in direction. Animals can do even better than this. I am indebted to Prof. Katz for communicating to me some results obtained in his laboratories at the University of Rostock by Engelmann[5]. Engelmann's method of testing the faculties of animals exhibits great ingenuity. Two similar screens placed side by side served to hide a source of sound, and, on a hook behind the screen hiding the source, was placed a piece of sausage. A dog was trained to associate the correct choice of the screen with the reward of a piece of sausage. By adjustment of the screens both as regards distance from the dog and of their distance apart, the limitations of the dog in the correct identification of the screen gave a measure of the angular separation of the screens, and hence the capacity of the dog to separate directions of sound. The experiments were carried out with three dogs, the dog "Asti" giving the remarkable performance of a separation 2°9′, corresponding to a time interval of 14/1,000,000 sec. A smaller dog, "Fritz", gave even better results: a separation of 1°16′ and time interval of 7/1,000,000 sec.

Experiments with cats, in which the source of sound was the rustle of two white mice in a cage, gave, in one case, a separation of only 48′ and a time interval of 2·8/1,000,000 sec. Experiments with hens and chickens gave other figures showing how very sensitive to sound direction for certain sound these creatures are. Here the source of sound which served as a test for the hen was the 'cheep' of the chick, and the chicken was tested on the cluck of the mother hen.

The following table shows the relative capacities of the various creatures as regards accuracy of direction finding; man is obviously outclassed.

| Subject | Base-length between ears | Accuracy of direction finding | Distinguishable time intervals between the ears |
|---|---|---|---|
| | | | ($10^{-6}$ sec.) |
| Man | 14 cm. | 4°18′ | 30 |
| Dog: | | | |
| "Asti" | 13 cm. | 2° 9′ | 14 |
| "Fritz" | 9 cm. | 1°26′ | 7 |
| Cat | 7 cm. | 48′ | 2·8 |
| Hen | 3 cm. | 2° 9′ | 3·3 |
| Chicken | 1·5 cm. | 2° 9′ | 1·6 |

I have emphasized so far the time difference explanation of this phenomenon of directional listening; but it may be objected that the direction finding of a continuous sound like an aeroplane cannot be so accounted for, since we would appear to have no discrete pulses on which we can observe such time difference. I have already referred to the quality of aircraft sounds and have mentioned its partly impulsive character. However much help may be derived from what is called the phase difference between the waves of incoming sound, our experience with troops has taught us that it is

these flutterings and pulses which appear to be given out irregularly that make direction finding easy. Even when the source of sound is entirely musical, atmospheric irregularities make the sound appear to fluctuate, and it is the time interval between the arrivals of these discrete fluctuations or flutterings which give the binaural sensation so prominently.

Now it must be admitted that this faculty of direction finding by sound grew naturally, both in men and animals, from the necessity of locating sounds nearly in the horizontal plane. With the advent of the aeroplane, we are faced with the necessity of listening to overhead sounds also, and here our listening mechanism shows a lack which it is probable Nature will never contrive to redress. When listening to the overhead sound, rotation of the head does not alter that time difference between the arrivals of the sound at the two ears upon which we depend for acquiring sense of direction, and this disability, although greatest in the overhead position, still persists, though in a gradually lessening degree, as the angle of elevation of the aeroplane is reduced. To get accuracies in the overhead position comparable with that of horizontal listening, the listener must make the axis of his body horizontal, that is, he must lie down with his length parallel to the course of the aeroplane before making use of his ears for direction finding. His head is then placed as well for locating the overhead sound as previously, when the body was erect, it was placed for locating sounds on the ground.

It may be that this uncertainty in placing an aeroplane which is overhead is responsible for the feeling experienced during the War that the bombing aeroplane seemed to spend an undue amount of time exactly over us, an impression, no doubt, which added to the terror of this overhead menace.

In the design of an efficient sound locator there is one obvious improvement to aid directional listening, namely, the artificial separation of the two ears. If we can, so to speak, pull the ears out of the head and separate them, we can increase for any given direction that time difference upon which a sense of direction depends. This pulling out of the ears can be done artificially by means of tubes placed in the ears with their open ends widely separated. If, further, the terminations of these tubes can be some type of sound collector, such as a horn, the improved directional properties can be supplemented by a magnification of the sound.

This was the fundamental principle which led to the design of the first British sound-locator, produced by the Anti-Aircraft Experimental Section of the Munitions Inventions Department under Prof. A. V. Hill. Four wooden horns were used on altazimuth mounting. The operation of direction finding involves two pairs of ears and two pairs of trumpets. The azimuth listener uses the horizontal pair which rotates about a vertical axis, while the altitude pair rotates about a horizontal axis. In operation, all the trumpets in a frame move together so that their mouths always point in the same direction.

It must be noted also that the azimuth listener must be on the correct bearing before the altitude listener can function correctly. This second pair of trumpets takes the place of hypothetical ears mounted on the crown of the head and under the chin, and the corresponding directional listening operation would be analogous to the nodding of the head after it has been swung round to face the sound.

In 1923, the Acoustical Section of the Air Defence Experimental Establishment had the problem of producing a portable sound locator which could be packed in a case after dismantling. The base length of 4 ft. 6 in. was used, but the horns were made smaller than in the early British pattern and, being metal-lined, withstood damage, for a fine crack in a wooden horn of the early type kills its magnifying properties. The performance of this locator after training was adequate for the slow moving and heavy bombing aircraft of ten years ago, but, owing to the high speed of modern aircraft, it is gradually losing its usefulness.

This magnification produced by horns is helpful because it reduces the reaction time of the listener; hence he gets on the correct bearing more quickly than if he were dealing with faint sounds. The horns, however, have another property which helps the listener. As they are rotated into the true direction, the intensity increases, and the listener will naturally turn the horn so that the sound is loudest. High-pitched sounds are more strongly magnified than the low-pitched sounds. The intensity variation as the horn rotates is also greater for the high-pitched sounds. We do not hear the aeroplane through the horns exactly as we hear it with the unaided ear, and, as we rotate them, the quality of sound changes, being richest when the horns face the sound.

We get, then, three factors affecting our correct estimate of direction—the binaural sense which

depends on time difference, giving us the sense of sound straight ahead when facing it, the intensity of the sound which becomes greater, and the quality of the sound which becomes richer and more closely resembles that of the aeroplane as heard by the unaided ear.

Of recent years, several well-known armament firms have produced sound locators in which great diversity of design has been exhibited. Sound collectors have been either of the horn type or have employed concave reflectors with special devices for conveying the sound to the ears. A modern example of the horn type is that produced by Sperry in the United States. Another type, produced by the firm of Barbier, Benard and Turenne, provides collectors each one of which is composed of a number of horns connected at their narrow ends. The Sautter Harlé locator, also produced in France, is of the reflector type, and so also is one produced by the firm of Goerz of Vienna, in which many striking acoustical features are introduced.

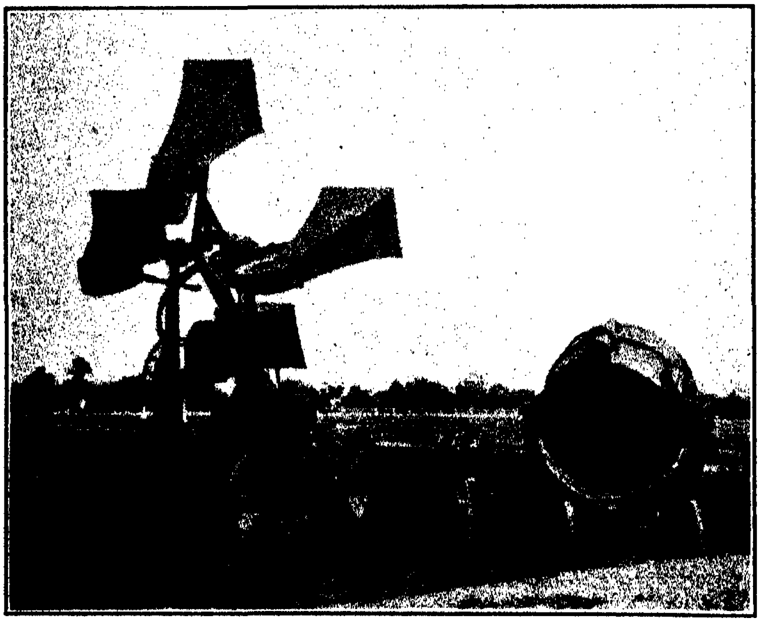

Fig. 1. The Sperry Sound Locator.

The Sperry sound locator (Fig. 1) consists of large exponential horns, that is horns with curved sides in which the cross-section diminishes in logarithmic relation with distance from the mouth. As such they accord with the latest scientific principles and, in fact, lend themselves to calculation both as regards frequency response and frequency range. They are 16 ft. long and give a base length of 7 ft. The listeners are, as it were, clamped to the horns by caps carrying earpads through which sound has access to the ear. They give an impressive magnification, but, unfortunately, are extremely resonant and, in even light winds, provide a disturbing background which hampers listening. This difficulty is overcome by a prolonged period of training. A feature of the trumpet which is liable to be overlooked is the danger to the listener of local gun sounds in which the gun blast is greatly concentrated. These Sperry locators, in the hands of trained troops, give a good performance.

By the way of comparison, the latest British sound-locator is shown (Fig. 2). Collectors which are paraboloid reflectors have been evolved as the result of researches in which the acoustical properties are accurately known. As in the best of the Continental locators, the instrument is trailer-mounted and the listeners adjust the positions of the locator and themselves by hand-wheel control. The instrument is highly directional, is free from trumpet resonance and can be used in moderately noisy surroundings.

In general, a condition of absolute silence is imposed in the neighbourhood of these locators while they are in operation, but with the new English locator it is quite possible to do effective work when onlookers are talking near it, so long as they keep away from the direction of listening.

Reviewing all these types of locator, it is interesting to note that, working on independent lines, the mouths of the collectors, which is an important feature of selective directional listening, and the length of the base between collectors, which determines accuracy of location, have achieved about equal dimensions throughout, but it must be confessed that some of the designs do not accord with the simplicity of the functions which they have to carry out.

Efforts of various countries have been concentrated hitherto on the production of sound locators in which the ear is the ultimate criterion. Directive listening is known to require training, and a certain proportion of military and civil

personnel are quite incapable of being trained. The British locator has proved itself to be a very rapid training instrument, but with all possible improvements, some listeners are physically incapable of good performance.

More recently, however, attention has been directed to the production of electrical locators in which it is hoped that difficulties of training will, to some extent, be eliminated.

It is only during the last year that microphones in Great Britain have been produced for all-round listening which can be matched as accurately as the ears are matched. The sensitivity of the microphones themselves is inadequate, and they must have amplifiers similar to wireless amplifiers, but of special design. These again must be matched, or they will, of themselves, introduce time errors or, better expressed, phase changes. Also, the power of discrimination of wanted from unwanted sounds, used automatically by the ears of the listener, must find its analogy in some electrical device, and recently we have been able to produce electrical filters which help to cut out the sounds which form an undesired background.

Finally, we should naturally replace the stethoscopes by telephones, which again must be matched, but that leads us back again to the ear with all its inherent difficulties. There is, however, an alternative to the ear in the cathode ray oscillograph, which may be used in a manner suggested by Dr. E. T. Paris. We have two receptors, so to speak, in the two pairs of parallel plates in the oscillograph, and the two microphone circuits may be connected to these so that each microphone effect can be recorded as a corresponding movement of the spot on the screen. Fig. 3 shows diagrammatically the four plates of the oscillograph, in which plates *aa* correspond to microphone *A* and plates *bb* to microphone *B*. The displacements *aa* and *bb* on the screen shown below correspond to their separate movements. These movements which are, of course, oscillatory, give by persistence of vision a straight line for each microphone, but when the two microphones are connected up, we get the well-known Lissajou figure, which would be another straight line equally inclined to the first two if these two microphone responses are in phase. When out of phase, the effect depends on the nature of the sound. If the sound is a pure musical tone, represented by a sine wave form, the intervening out-of-phase conditions are represented by ellipses. If, however, the source of sound is as complex as that of an aircraft, and is built up of many frequencies, the pattern only becomes simple, that is, the straight line above referred to, if all the constituents are in phase, namely, when the microphones are equidistant from the source.

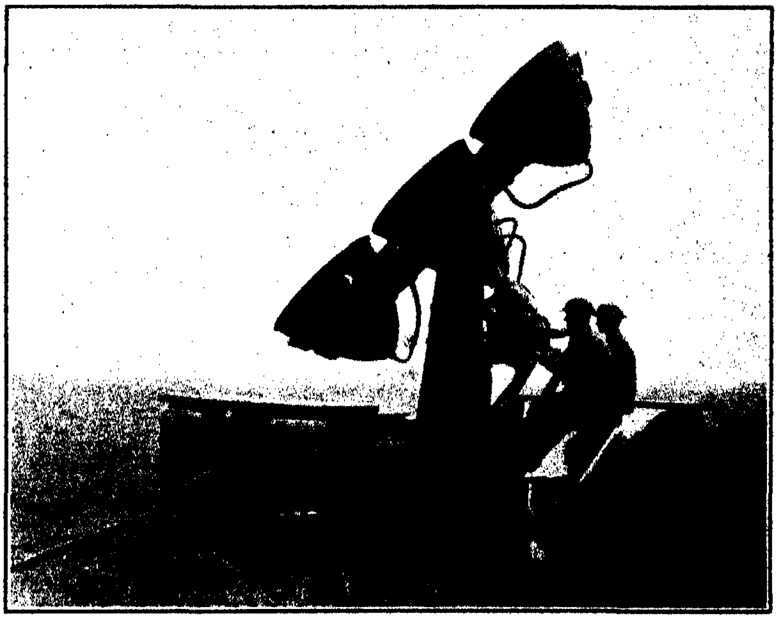

FIG. 2. MODERN BRITISH SOUND LOCATOR.

Gusty winds make directional listening very difficult; for the critical time difference on which direction finding depends becomes variable. The cathode ray oscillograph gives a perfect picture of this disability. The straight line then becomes blurred, and if the sound intensities change, as they do in the two receivers, at unequal rates, the resultant line oscillates. The aural and visual perceptions give an exact parallel. Similarly, other sources of sound, or, it may be reflections of the same source, confuse both aural and visual effects equally. This method of visual indication by the cathode ray oscillograph gives immediate evidence of listening disabilities.

I have so far dealt with sound direction finders in which the two ears or their equivalents in microphones are necessary. There are, however,

direction finders in which use is made of single collectors which can rotate to face the sound and so find a maximum of intensity. Although these direction finders are of considerable interest, they fail to give the accuracy shown by the binaural instruments, and, furthermore, present difficulties in recovering the direction of the sound when it is lost.

I will only give one example of this type, which is of interest in so far as it is entirely devoted to peace operations, and deals with the direction finding of fog horns and ships' sirens at sea. The need of supplementing the human ear has been recognized by many navigators, especially as meteorological conditions sometimes baffle the listeners. Situations may also arise when the

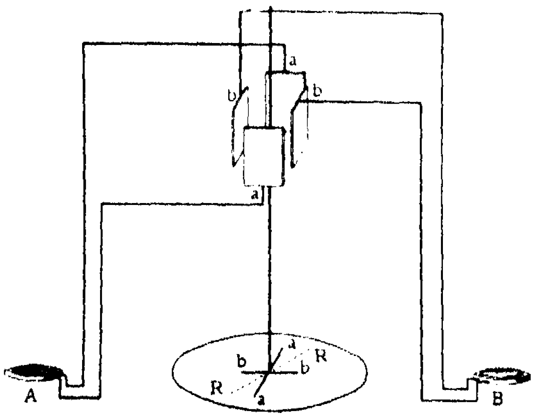


FIG. 3. DIAGRAM OF CATHODE RAY OSCILLOGRAPH.

nearness of the foghorn involves hasty and definite action. The invention of Messrs. W. and T. G. Hodgkinson is directed to the supply of accurate bearings (to half a point of the compass).

The devices tried out were of two types. The first and simpler form of direction finder consisted of a paraboloidal receiver mounted in a drum rotatable about a vertical axis. The axis of the paraboloid was horizontal and coincided with a diameter of the drum. At the focus of the paraboloid a contact microphone was mounted, and the mouth of the paraboloid was protected from wind by a perforated screen. Microphone adjustments were such that the noises of the ship on which it was erected and disturbances from wind produced little effect, but it would respond to horns and sirens up to ranges of three miles. The axis of the drum carried a commutator, and brushes were arranged so that, for sixteen positions of the drum, currents generated by sound in the microphone could light a lamp through the agency of a relay. Sixteen of these lamps were arranged in a dial to give the points of the compass against which any sound disturbance could be anticipated. For near foghorns, a group of lights might be shown on a definite arc, the centre of which would give the bearing. This instrument was used for a period on the Mersey pilot-service and on the Holyhead–Dublin mail service. A later pattern, where a much larger drum was used, avoided the operation of rotating the drum, the same effect being achieved by using a number of radial paraboloid receivers, each with its own light indicator. This was installed on S.S. *Victorian* of the Allan Line on the Liverpool–Montreal service. The instrument, though successful, was not brought into general use.

It may be suggested that considerable gain might be achieved by using very large receivers. This development, however, has not been pursued because it has been discovered that appreciable increase in acoustical range has not been comparable—a result which can be attributed to the very high attenuation of sound in the atmosphere. The application of the inverse square law is not helpful in estimating range extension, since, at greater distances than normal listening, the attenuation losses are high in comparison with those due to spherical divergence. Very large receivers have been tried and have resulted in very disappointing performance at long ranges. Thus, large exponential horns which admittedly magnify very impressively, will add only a few miles to the audible range. A gain in accuracy of direction finding may be achieved, but, even so, the accuracy obtained by a single large receiver working on a maximum of intensity cannot compete with that derived by employing the binaural effect, using pairs of receivers of more modest dimensions.

It is obvious that no description of sound direction finding would be adequate without reference to two sources of error. The first one, which applies to the location of all sources of sound, whether fixed or moving, is due to the physical nature of the atmosphere. The effect of wind in creating difficulties of listening range is, of course, familiar, and I do not wish to dwell on this. Meteorological acoustics is a science of itself and might easily occupy the whole of this discourse. It is my purpose rather to indicate in a few words how wind and temperature may affect the direction of listening. We may regard the velocity of sound

in still air at uniform temperature as a physical constant, but air is very rarely still and never at a fixed temperature as we ascend. We must increase or decrease the velocity of sound according as the wind is with or against the direction of travel, and according as the temperature increases or decreases. The effect of the variation is to produce refraction, to a greater or less degree, and the effects of these variations have been worked out precisely from mathematical considerations[5]. The following simple illustrations indicate in what manner meteorological conditions affect directional listening. If we consider the wind to increase with height in the direction of listening, the sound ray comes down more steeply. If opposite to the direction of listening, the sound ray is bent so that it comes in at a smaller angle. For example, in a illustration is shown in Fig. 4, where the directions of sound rays given out by an aeroplane at 7,000 ft. are mapped out. This acoustical distribution of rays can be worked out if we know how wind and temperature change as we ascend. Here, the sound rays spread in such a way as to give a region in which no sound is heard, hence no direction can be defined; but above and below it there are errors in direction as shown. Provision for such corrections will eventually be made, for, if sound is to be employed for controlling gun fire, great accuracy will be essential in obtaining direction.

The survey of the atmosphere as regards wind and temperature has been accessory to a large research (now being carried out by P. Rothwell) on the refraction of sound in the atmosphere.

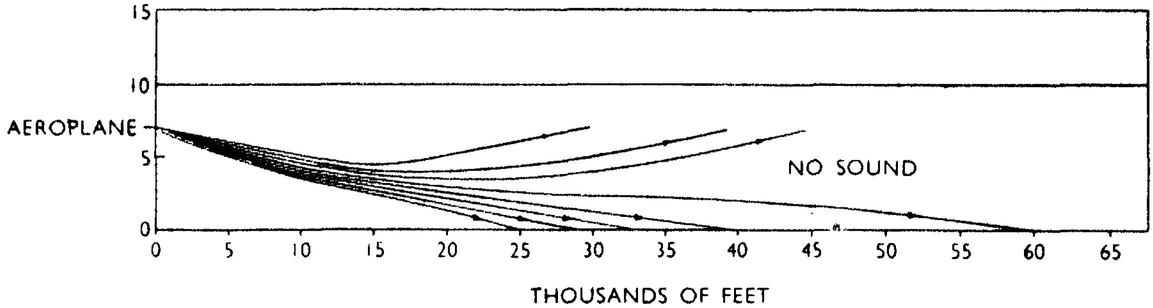


FIG. 4. DIRECTIONS OF SOUND RAYS FROM AN AEROPLANE AT 7,000 FT.

south-west wind so prevalent in England, an aeroplane would be heard in a south-west direction at a higher angle than the true, or, if with the same wind we listen to an aeroplane in the north-east, we should be hearing it at a lower angle. The reason is that wind from the south-west increases as we ascend in nearly all cases.

The effect of the temperature is such that, if no wind had to be allowed for, the aeroplane would always be heard at a lower angle of elevation than it actually is. The reason is that the temperature during the day is nearly always lower as we ascend, and, in consequence, the velocity decreases. The effect is the same as if we were listening against the wind, as described above. At night, however, the reverse effect frequently occurs, because the ground cools by radiation and the temperature of the air above it is higher. At night therefore it frequently happens that we hear an aeroplane at a greater angle of elevation. These effects are quite large, as much as 10° for very low angles of elevation, but when the aeroplane approaches the overhead position, these errors become negligible. An

A more serious error in sound direction finding occurs if the source of sound is moving. The small velocity of sound relative to that of light is responsible for an error called the 'lag of sound', and it can be defined as the angle between the line of sight and the direction of listening. Taking an aeroplane as the moving source, while the sound which it gives out is approaching the listener, the aeroplane has travelled on its course, so that the listening direction will always be behind the visual one. The lag of sound varies according to the direction in which we are listening. If the aeroplane is coming straight towards us or receding from us, there is no correction; but if it is flying across our field of vision, such as it would be if vertically overhead, the lag of sound is a maximum. The angle thus becomes approximately $\varphi = v/V$ where $V$ is the speed of sound and $v$ the air-speed of the target, but a wind correction must be incorporated with this if the wind varies between the aeroplane and the ground. No correction is necessary if there is no wind. How large the correction may be is indicated in the accompanying

table, which gives the angular lag of listening direction for an aircraft flying overhead. Against this correction, a year is quoted, corresponding roughly to the speeds of aircraft prevalent at that time.

| | Air speed: miles per hour | Angular error overhead position |
|---|---|---|
| 1918 | 60 | 4·6° |
| 1926 | 120 | 9·1° |
| 1934 | 180 | 13·8° |
| 1936 | 240 | 18·4° |
| 1940? | 300 | 23·0° |

The corrections would suggest a very serious disability in sound locating, but this disability may easily be exaggerated, for, if we know the airspeed of the aircraft and the direction in which it is travelling, corrections may be applied with considerable precision. The various sound locators have devices attached to them which insert the lag of sound corrections and, in some cases, corrections for wind and temperature refraction.

We must, of course, remember that acoustical direction finding cannot compete with the precisions of visual observations, but it is not too much to say that, on fixed sources of sound, an error of ¼° can be assured with the modern instruments, and with an aeroplane flying at reasonable heights, all sound locator manufacturers quote 2° accuracy. The distance away of the target is, of course, a determining factor, as with low-flying targets having a high angular velocity, difficulties of following, both physical and psychological, make the operation of direction finding difficult. By careful training, a listening team of two listeners per locator can achieve an accuracy of 1° for a reasonable proportion of the time during which the aircraft is within hearing and at heights above 5,000 ft.

Is sound as an aid to defence likely to be completely outclassed because of its low velocity? We are apt, with the sensational reports of greater and greater speeds of aircraft, to exaggerate the heavy handicaps from which sound suffers. In direction finding, it is true that a large correction may be involved, but, if it is an accurate one, the result may still be adequate for the purpose for which sound locators were designed. We are by no means approaching yet the stage described in the well-known petrol advertisement, and we have one consolation in the fact that very high-speed aircraft produce much stronger sounds than those flying at lower speeds, so that what we lose in time through high speed we gain in range of audibility.

It is not desired, however, to close on the note of war. We are endowed with a directional listening faculty, the study of which has been seriously neglected. We scarcely appreciated that we had this faculty until sound locators were designed and time differences exaggerated, so that an almost uncanny throwing of our perception of sound from one ear to the other was observed only by a slight rotation of such instruments.

We have claimed the impulsive character of the aircraft sound as a valuable asset in sound direction finding, and we have been able to explain the phenomenon of direction listening on the time difference theory of Hornbostel. It has, however, been the subject of psychological researches to try if sense of direction is lost when the sounds are pure tones. Banister[6] has by suitable laboratory equipment tested certain observers on pure tones and has come to the conclusion that tones of frequency ranging from 133 cycles to 1,705 cycles can give a binaural effect and that discrete impulses are not essential. Our own experience is that lower frequency pure tones are very difficult to locate.

Banister has attempted to reconcile these results with Hornbostel's theory of time differences and has produced a theory which may explain why such an operation is possible. The crests of the sound wave, so to speak, can fulfil the function of discrete pulses, if certain assumptions are made on the mechanism of the ear.

These and other experiments on the theories of hearing should benefit by the attention now being devoted to sound direction finding, and it is hoped that instruments devised specifically to defend us against war dangers will thus give an impetus to work of purely scientific value.

[1] J. Regen, *Sitz. Akad. Wiss. Wien*, Math.-Naturwiss. Kl., (1), **132**, 81 (1924).

[2] Engelmann, "Untersuchungen über die Schall-lokalisation bei Thieren". (J. A. Barth, Leipzig.)

[3] E. M. von Hornbostel. "The Time Theory of Sound-Localization". Physical Society Discussion on Audition, June 19, 1931.

[4] "Dictionary of Applied Physics", vol. 4, p. 733.

[5] E. A. Milne. "Sound Waves in the Atmosphere". *Phil. Mag.*, **42**, 100 (1921). Tucker. "Some Problems of Modern Meteorology. No. 11 Meteorological Acoustics". *Quart. J. Roy. Met. Soc.*, **59**, No. 250, July, 1933.

[6] H. Banister. "The Basis of Sound-Localization". Physical Society Discussion on Audition, June 19, 1931.

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the bulkiness of the 'stitched' edges of a pile of loose issues is to some extent minimized. The 'binder' has an attractive dark green imitation leather finish, it is easy to manipulate, and is a convenient means of keeping loose issues together pending binding up a volume, or even permanently. The price of the binder is 3s. 6d. (4s. including postage).

### Civil List Pensions

AMONG the Civil List pensions granted on March 12 and recently announced in a White Paper (H.M. Stationery Office, 139, price 1d.) are the following pensions for services to science: Miss A. M. Buckton, in recognition of her services to literature and of the services rendered by her father, the late Mr. George B. Buckton, to entomology, £60; Mrs. S. I. Cunningham, in recognition of the services rendered by her husband, the late Mr. J. T. Cunningham, to zoology, £90; Miss R. M. Fleming, in recognition of her services to anthropology and geography, £80; Mrs. C. D. Hodgkinson, in recognition of the services rendered by her husband, the late Prof. W. R. Hodgkinson, to chemistry, £90; Mrs. B. Kaye, in recognition of the services rendered by her husband, the late Mr. W. J. Kaye, to the study of archæology, £60.

### Grants for Cancer Research

AT the recent quarterly meeting of the Grand Council of the British Empire Cancer Campaign, grants totalling £5,296 were approved; £1,187 to Dr. A. Pollard, working at the Courtauld Institute of Biochemistry at the Middlesex Hospital, on a special scheme of biochemical research inaugurated by the Scientific Advisory Committee; £150 to Dr. F. G. Spear, working at the Strangeways Research Laboratory, Cambridge, for the purchase of a low-voltage equipment apparatus, and £700 for the purchase of a 200 k.v. 10 m.a. Greinacher set; £300 for six months for work being carried out under the direction of Mr. F. C. Pybus through the North of England Council of the Campaign; £1,256 for fifteen months to Dr. Alexander Haddow, who is transferring from his research appointment in Edinburgh to continue special research work at The Royal Cancer Hospital (Free); £320 to Mr. Nevill Willmer, working at the Physiological Laboratory, Cambridge, for technical assistance and purchase of apparatus; and £150 for six months to Dr. Alice Leigh-Smith, working under the direction of Dr. Thomas Lumsden at the London Hospital.

### The Structure of Aneurin and Thiochrome

MESSRS. F. BERGEL and A. R. TODD point out that in their letter under this title in NATURE of July 11 (p. 76), formulæ I and II are printed with HCl apparently attached to carbon atom 5′ of the thiazole nucleus; actually the HCl should be represented merely as attached to the molecule as a whole, since it cannot be allocated with certainty to any particular nitrogen atom; it cannot, of course, be attached to a carbon atom. In formula III a single bond should be inserted between $C_4$ of the pyrimidine ring and the thiazole nitrogen.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in biology in The Polytechnic, Regent Street, London, W.1—The Director of Education (July 20).

A lecturer in mechanical engineering in the Burnley Municipal College—The Director of Education, Education Offices, Burnley (July 20).

An assistant in the Mechanical Engineering Department and an assistant in the Electrical Engineering and Physics Department of the Coventry Technical College—The Director of Education, Council House, Coventry (July 22).

Mechanical engineers for the Supply Board Technical Establishment under the Director of Ordnance Factories—The Under-Secretary of State (C.5), War Office, London, S.W.1 (July 24).

Four instructors in motor engineering in the South-East Essex Technical College—The Clerk to the Governors, Five Elms Council School, Wood Lane, Dagenham (July 24).

A lecturer in mathematics, and three lecturers in engineering, in the Acton Technical College, High Street, Acton, 3—The Principal (July 24).

A lecturer and deputy director of the Department of Anatomy in the St. Thomas's Hospital Medical School, London, S.E.1—The Dean (July 24).

An assistant lecturer in physics in the University of Manchester—The Registrar (July 29).

A lecturer (Grade IIb) in electrical engineering in the University of Birmingham—The Secretary (July 29).

Junior scientific officers in the Directorate of Scientific Research of the Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (July 31).

A head of the Department of Mechanical Engineering in the Bradford Technical College—The Principal (July 31).

A civilian scientific officer in the Admiralty Scientific Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (July 31) (quote C.E. 3709/36).

A demonstrator in chemistry in the University of Aberdeen—The Secretary (August 8).

A temporary assistant lecturer in chemistry in the University of Manchester—The Registrar (August 8).

Two part-time demonstrators in inorganic chemistry in the University of Leeds—The Registrar (August 15).

A lecturer in fuel technology in the University of Sheffield—The Registrar (August 15).

A lecturer in metal mining in the University of Birmingham—The Secretary (August 15).

A University reader in physiology in the London Hospital Medical College—The Academic Registrar, University of London, S.W.7 (September 11).

A part-time lecturer in science in St. Paul's Training College, Selly Park, Birmingham—The Principal.

A part-time demonstrator in mathematics in University College, Southampton—The Registrar.

An assistant lecturer in geography in University College, Hull—The Registrar.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 128.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Atomic Masses of Uranium and Thorium

WITH ions from a spark between a thorium or uranium electrode and a tin electrode, it was found that easily resolved doublets are given by the mass-spectrograph, formed by the doubly charged thorium ions with the tin isotope at 116 in one case, and in the case of uranium with the isotope at 119 (Fig. 1). The mass difference is found to be 0·120 ± 0·003 for thorium (the average of six doublets of nearly equal intensity), and 0·131 ± 0·003 in the case of uranium (average of the values for the five best doublets). The packing fraction for the tin isotopes has been determined by Dr. Aston[1] as 7·3 ± 1. Using this value, the atomic mass of thorium (oxygen = 16·000) is 232·070 and that of uranium 238·088.

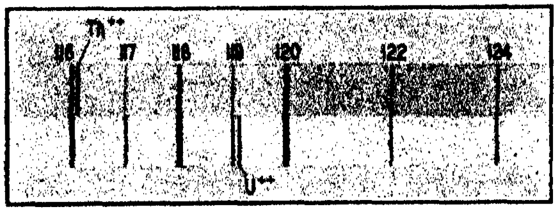



FIG. 1. Ions from electrons of tin and thorium (above) and tin and uranium (below).

Doubly charged ions of the faint isotope of uranium[2] at 235 appeared on four photographs, unsymmetrically spaced between the tin lines at 117 and 118. Its mass was found to be 235·084 ± 0·01. The proportion of this isotope is 0·4 per cent, according to the actino-uranium theory. Reduced to the chemical scale, the atomic weights become 232·024 for thorium and 238·028 for the mean of the two uranium isotopes, as compared with the usually accepted values 232·12 and 238·14. The discrepancy of approximately one tenth of a unit is too large to be ascribed to an error in the masses of the tin isotopes.

From their analysis of the transformations induced by neutron bombardment of uranium, O. Hahn, L. Meitner and F. Strassmann[3] have recently concluded that a uranium isotope of mass 235 exists with a half-life of only 24 minutes. It is transformed by β-ray emission into eka-rhenium ($N = 93$) of the same mass, which is probably a long-lived product. As the uranium and pitch-blende samples used in the present experiments were of unknown origin, analyses of the uranium ions from purified samples of uranium salts were made to make sure that the faint component is an isotope of uranium and not by any chance eka-rhenium. Pure uranyl nitrate crystals were heated and packed in a nickel tube. With this electrode the isotope at 235 was observed apparently in the same ratio as with the other electrodes. No precipitate was obtained by hydrogen sulphide, showing the absence of an appreciable amount of eka-rhenium. The uranium was next freed from other elements by precipitating it as sodium uranyl acetate. This salt when heated and used as the electrode also gave the isotope at 235 just as before. Since this long-lived isotope at 235 thus belongs to uranium, the short-lived isotope formed by neutron bombardment must be isomeric with it, the two having the same mass and charge but differing in nuclear properties.

A. J. DEMPSTER.

University of Chicago.
June 12.

[1] F. W. Aston, *Proc. Roy. Soc.*, A, **115**, 506 (1927).
[2] A. J. Dempster, NATURE, **136**, 180 (1935).
[3] O. Hahn, L. Meitner, F. Strassmann, *Ber. deut. chem. Gesell.*, **69**, 913 (1936).

## Unimolecular Elimination and the Significance of the Electrical Conduction, Racemization and Halogen Replacement of Organic Halides in Solution

THERE are a number of cases in which the development of electrical conductivity in sulphur dioxide solution has been held to indicate the electrolytic dissociation of an alkyl halide. One of the best known examples is that of *tert.*-butyl iodide[1]. We find, however, that *tert.*-butyl chloride absorbs bromine quantitatively in sulphur dioxide, the products being *iso*butylene dibromide and hydrogen chloride. This suggests a rather rapidly established equilibrium,

$$Me_3CCl \rightleftharpoons Me_2C : CH_2 + HCl,$$

in which, however, the left-hand components have the smaller free energy. α-Phenylethyl chloride also is said to give a conducting solution in sulphur dioxide: we find that the pure chloride in the pure solvent does not conduct, but that when there is conduction, styrene and hydrogen chloride are present:

$$CHPhMeCl \rightleftharpoons CHPh : CH_2 + HCl.$$

Under conditions of purity in which the chloride does not conduct, hydrogen chloride itself has negligible conductivity in small concentration, but even in these circumstances the addition of bromine leads to a quantitative yield of styrene dibromide.

Observations of the unimolecular racemization of optically active alkyl halides have also been held to measure their rates of electrolytic dissociation or at least their ionization. α-Phenylethyl chloride has been shown to racemize in sulphur dioxide at a rate which is unaffected by added chloride ions[2]. A similar but more rapid racemization has been observed with formic acid as solvent[3]. In formic acid also styrene and hydrogen chloride are formed; we find, moreover, that the rate of racemization is substantially accounted for by the rate of formation of

hydrogen chloride. In sulphur dioxide a direct comparison of rates is scarcely possible owing to the one-sidedness of the equilibrium.

The unimolecular replacement in sulphur dioxide[4],

$$CHPhMeCl + I^- = CHPhMeI + Cl^-,$$

is open to the same explanation, since styrene adds hydrogen iodide, which would be formed from the added iodide ions and the liberated hydrogen chloride. Several supposed rearrangements can be similarly re-interpreted.

We are thus able to group all these conductometric, polarimetric, kinetic and other observations under our general mechanism (customarily labelled *E*1) for unimolecular elimination reactions:

$$\left.\begin{array}{lll} >CH.CR_2.X & \xrightarrow[\text{slow}]{} & >CH.\overset{+}{C}R_2 + \overset{-}{X} \\ >CH.\overset{+}{C}R_2 & \xrightarrow[\text{fast}]{} & >C:CR_2 + \overset{+}{H} \end{array}\right\} \quad . \ . \ (E1)$$

This mechanism assumes that the rate-determining stage is the ionization of the halide, and to this extent we support the inference drawn by previous investigators[1,2] to the effect that ionization is fundamentally involved. In our mechanism the instability of an alkyl cation containing a potential proton is made responsible for the production of olefin.

Experimental particulars and more extended applications of the *E*1 mechanism will be published in the *Journal of the Chemical Society*.

E. D. HUGHES.
C. K. INGOLD.
A. D. SCOTT.
University College,
London.
July 1.

[1] Walden, *Ber.*, **35**, 2029 (1902).
[2] Bergmann und Polanyi, *Naturwiss.*, **21**, 378 (1933).
[3] Bodendorf und Böhme, *Annalen*, **516**, 1 (1935).
[4] Ogg and Polanyi, *Trans. Faraday Soc.*, **31**, 617 (1935).

## Equilibria in Salt Systems with Deuterium Water

IN connexion with the letters of Bell[1], of Partington and Stratton[2] and with editorial notes[3], it is of interest to note the degree of activity in this field. As is justly stated in the second letter cited above, "measurements of dissociation pressures of salt hydrates are somewhat difficult". By way of illustration, whereas Perpérot and Schacherl[4] report a value for the dissociation pressure equilibrium at 25° of cupric sulphate penta- and tri-deuterates which is 36 per cent lower than the corresponding value for the ordinary hydrates, two of us in 1934 had found this pressure difference to be only 8 per cent. We shall therefore welcome the promised results of Partington and Stratton. We have studied pressure equilibria in this and other univariant salt deuterate systems with and without the liquid phase (saturated solution) present, over a range of temperature.

The solubility relations of salts in deuterium water seem to have received less attention[5]. A few results may perhaps be of interest. If, following "International Critical Tables", concentration is stated in terms of moles of anhydrous solute per 1,000 gm. (55·51 moles $H_2O$) in the case of ordinary water, for purposes of comparison we may state the number of moles of solute per 1111·7 gm. (55·51 moles $D_2O$) in the case of deuterium water. For potassium chloride on this basis, we find the solubility in deuterium water lower than that in ordinary water by about 7 per cent at 30°, 3·6 per cent at 100°, and 1·5 per cent at 180°.

In speaking of the solubility of deuterates and hydrates, we refer to solubilities in deuterium water and in ordinary water respectively. Cupric sulphate pentadeuterate is, at 10°, nearly 12 per cent less soluble than pentahydrate; but the difference in solubility falls to about 1·5 per cent near 96°, which is close to the transition temperatures of both salts to their tri-aquo forms. Strontium chloride hexahydrate passes to dihydrate at 61·3°, and the hexadeuterate to dideuterate about 56·5°. The graph of solubility of hexadeuterate against temperature lies lower in concentration than that of the hexahydrate at lower temperatures but crosses the hexahydrate curve about 10°; the dideuterate solubility curve crosses the hexahydrate curve about 60° and the dihydrate curve about 115°, both deuterate curves showing a faster change of solubility with temperature than the corresponding hydrate curves.

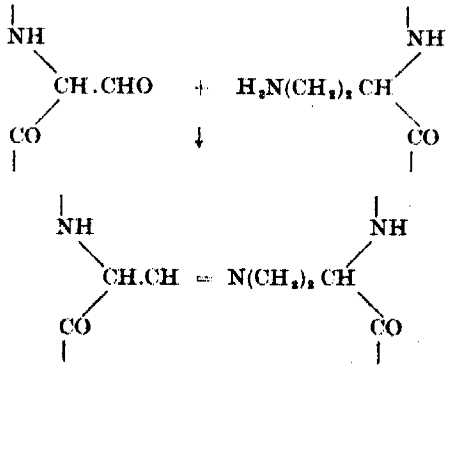
F. T. MILES.
R. W. SHEARMAN.
ALAN W. C. MENZIES.
Princeton University,
June 5.

[1] NATURE, **137**, 534 (1936).
[2] NATURE, **137**, 707 (1936).
[3] NATURE, **137**, 698 (1936).
[4] *J. Phys. et le Rad.*, vii, **6**, 439 (1935).
[5] But cf. Taylor, Caley and Eyring, *J. Amer. Chem. Soc.*, **55**, 4334 (1933).

## Cross-Linkage Formation in Keratins

THE depilation of hides and skins prior to tannage[1], and the permanent setting of stretched hair and wool[2] are both important industrial processes considered to be governed by the development of resistant cross-linkages between the peptide chains of keratins. Speakman[2] has suggested that when stretched wool fibres are set in steam, the cross-linkages developed consist of –S–NH– groupings formed subsequent to the hydrolysis ($R.S.S.R. \rightleftharpoons R.SH + HOS.R$) of the cystine disulphide cross-linkages; but it is admitted that other resistant linkages must be formed when cross-linking is attended by loss of sulphur.

A possible chemical mechanism, hitherto overlooked, for the production of such resistant linkages may arise by the auto-oxidation-reduction of the sulphenic acid side-chains produced by the hydrolysis of the cystine disulphide cross-linkages. Such decomposition of the sulphenic acid side-chains would yield hydrogen sulphide, and aldehyde groups ($>CH.CH_2.SOH \rightarrow >CH.CHO + H_2S$) capable of linking-up with the amino-groups of adjacent peptide chains, for example, those of lysine.



That the sulphenic acid radical can decompose in this manner is indicated by the production, with the liberation of hydrogen sulphide, of glyoxylic acid from dithiodiglycollic acid, and of phenylglyoxylic acid from dithiodiphenylglyoxylic acid[3]. Keratin is also known to evolve hydrogen sulphide under the action of steam, and to lose 50 per cent of its sulphur when treated with sodium hydroxide[4].

On the assumption that the cystine disulphide cross-linkages must be severed before hair can be removed rapidly from hides, the above hypothesis explains why fresh lime liquors are not efficient depilators, unless they contain reducing agents, for example, sodium sulphide. These substances reduce the sulphenic acid side-chains to cysteine side-chains and thus prevent the generation of aldehyde groups. The unexpected ability of aliphatic primary amines[5] (especially methylamine) to facilitate depilation by fresh lime liquors (free from reducing agents) may also be due to the prevention of cross-linking, since these amines could condense with, and mask, the aldehyde groups arising by the sulphenic acid decomposition.

H. PHILLIPS.

Wool Industries
Research Association,
Torridon,
Leeds, 6.

[1] Marriott, *J. Int. Soc. Leather Trades Chemists*, **12**, 216 (1928).
[2] Speakman, NATURE, **132**, 930 (1933).
[3] Schöberl, *Annalen*, **507**, 111 (1934); *Ber.*, **67B**, 1545 (1934).
[4] Harris, *Bur. Stand. J. Res.*, **15**, 63 (1935).
[5] McLaughlin, Highberger and Moore, *J. Amer. Leather Chem. Assoc.*, **22**, 345 (1927).

## Association and Dissociation Reactions of Thyroglobulin

FROM their ultracentrifugal studies on thyroglobulin, Heidelberger and Pedersen[1] found that solutions of this protein within its $p$H stability region[2] are fairly homogeneous (Fig. 1). The sedimentation picture shows, in addition to a predominating component consisting of molecules having a molecular weight of about 700,000, a small amount of heavier and lighter molecules with poorly defined sedimentation boundaries. These molecules were assumed to have been formed respectively by the dissociation and association of the molecules comprising the predominating component. It was noticed that on dilution the number of lower molecular weight molecules increased.

In the study of the stability of thyroglobulin being carried out by means of the ultracentrifuge, I have been able to confirm the previous work. I find, however, that this protein dissociates in dilute solutions provided a number of other conditions are fulfilled. Furthermore, I find that the same factors are concerned in the association of thyroglobulin into molecules of higher molecular weight. Finally, I conclude that the number and size of molecules present in a given solution of thyroglobulin may be defined by the following set of variables: protein concentration, salt concentration, temperature, dielectric constant, $p$H and the time the solution has been standing under a given set of conditions.

Those conditions which favour the dissociation of thyroglobulin are as follows: low protein concentration, low salt concentration, elevated temperature, high dielectric constant (glycine and urea were added to the thyroglobulin solutions in this set of experiments), a $p$H displaced from the isoelectric point (only values on the alkaline side, but still within its $p$H stability region, have been studied). These are the same conditions which favour the ionization of the protein.

On the other hand, those conditions which favour the association of thyroglobulin are the opposite or the same as those which minimize the ionization of the protein.

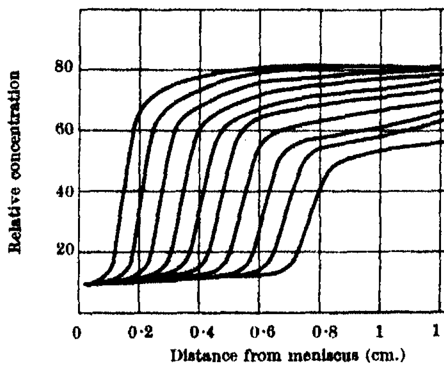



FIG. 1. Sedimentation diagram of thyroglobulin prepared essentially to reference 3.

When placed under the proper combination of conditions, thyroglobulin dissociates with a slow and measurable rate into a series of components of lower molecular weight having well-defined sedimentation boundaries (Fig. 2). I have been able to reverse the reaction, resynthesising the original molecule from the dissociated fragments. Moreover, under the proper conditions, thyroglobulin will associate in due course into higher molecular weight components having definite sedimentation boundaries.

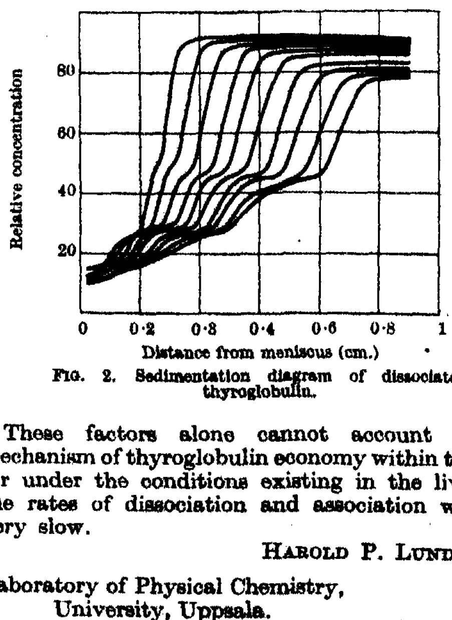



FIG. 2. Sedimentation diagram of dissociated thyroglobulin.

These factors alone cannot account for the mechanism of thyroglobulin economy within the body, for under the conditions existing in the living cell the rates of dissociation and association would be very slow.

HAROLD P. LUNDGREN.

Laboratory of Physical Chemistry,
University, Uppsala.
May 13.

[1] M. Heidelberger and K. O. Pedersen, *J. Gen. Physiol.*, **19**, 95 (1935).
[2] M. Heidelberger and T. Svedberg, *Science*, **80**, 414 (1934).
[3] M. Heidelberger and W. Palmer, *J. Biol. Chem.*, **101**, 433 (1933).

## Raman Spectrum of Cyclopropane

THE Raman spectrum of cyclopropane is of great interest in view of the fact that it is the simplest of the cyclic hydrocarbons, and also from the point of view of the structure of the cyclopropane molecule. I have investigated this substance both in the liquid and vapour states and have obtained the following results:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Liquid | $\Delta\nu$ (cm.$^{-1}$) | 736* | 863 | 1185 | 1434 | 1503* | 2852* | 2952* | 3010 | 3028 | 3080 |
| | Int. | 0*bd* | 8*b* | 15 | 2*b* | 0*s* | ½ | 1 | 10 | 10 | 6*bd* |
| | $\varrho$ | *D* | *D* | *P* | *D* | *P* | *P* | *P* | *P* | *P* | *D* |
| Vapour | $\Delta\nu$ (cm.$^{-1}$) | | 863 | 1185 | | | | | 3010 | 3028 | |
| | Int. | | 0*b* | 2*s* | | | | | 1*s* | 2*s* | |

*b* = broad; *d* = diffuse; *s* = sharp; *P* = polarised ($\varrho \lessdot 6/7$)
*D* = depolarised ($\varrho \approx 6/7$).

The frequencies marked with an asterisk in the case of the liquid have not been noticed by the previous investigators[1,2] and are reported here for the first time. The strongly polarised Raman line at 1185 cm.$^{-1}$ and the depolarised Raman line at 863 cm.$^{-1}$ presumably represent the totally symmetric and the deformation vibrations respectively of the triangular carbon ring which forms the nucleus of the cyclopropane molecule. However, for an equilateral triangular model, the doubly degenerate deformation frequency is forbidden in the Raman effect according to Placzek's selection rules. The fact that the Raman line at 863 cm.$^{-1}$ persists even in the vapour state clearly shows that its appearance in the liquid spectrum cannot be due to the influence of the neighbouring molecules. The influence of the hydrogen atoms on the vibrations of the carbon ring might be a possible explanation for the appearance of this line. The matter, however, requires mathematical investigation.

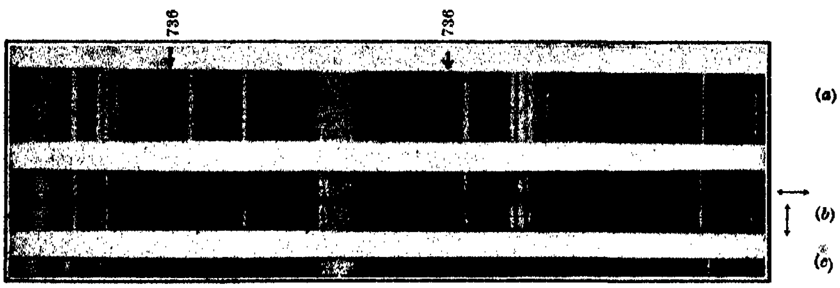


FIG. 1. Raman spectrum of cyclopropane; *a*, liquid; *b*, liquid (polarisation); *c*, vapour.

A striking difference between the liquid and the vapour spectra is noticed when we compare the Raman lines at 3010 cm.$^{-1}$ and 3028 cm.$^{-1}$. In the liquid picture, these two lines are of equal intensity or perhaps $\Delta\nu = 3010$ cm.$^{-1}$ is slightly more intense than $\Delta\nu = 3028$ cm.$^{-1}$. The intensity of either of these is less than that of the Raman line at 1185 cm.$^{-1}$. In the vapour picture $\Delta\nu = 3010$ cm.$^{-1}$ is found to have become considerably weaker, while $\Delta\nu = 3028$ cm.$^{-1}$ has gained in intensity and is almost as strong as Raman line 1185 cm.$^{-1}$ Such a strong difference between the relative intensities of the Raman lines between vapour and liquid in the case of a non-polar molecule is remarkable, and evidently requires further elucidation.

R. ANANTHAKRISHNAN.

Department of Physics,
Indian Institute of Science,
Bangalore. May 6.

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[2] K. W. F. Kohlrausch and F. Koppl, *Z. phys. Chem.*, B, 26, 209 (1934).

## Electronic Specific Heat in Palladium

KEESOM and Clark[1] have shown that the atomic heat of nickel at low temperatures contains a linear term $0 \cdot 0019\ T$, which is many times bigger than the contribution from the free electrons to be expected from the Sommerfeld theory. Mott[2] has suggested that this term is due to the unfilled quantum states (positive holes) in the $d$-shell of nickel, and that a similar term should occur for the other transition metals, whether ferromagnetic or paramagnetic.

In order to test this theory and to make more quantitative data available on the subject, the specific heat of palladium was determined, palladium being chosen on account of its similarity to nickel and its high paramagnetism, which according to Mott should imply a large electronic specific heat. Though the electronic component in these transition metals is larger than usual, it is nevertheless small in absolute magnitude. But since it varies proportionally with the temperature, whereas the specific heat due to the lattice vibrations varies near the absolute zero with the cube of the temperature, the two become comparable in magnitude at sufficiently low temperatures[3]. Experiments were therefore carried out in the liquid helium region.

The specific heat of a block of metallic palladium (weighing 25 gm.) kindly put at our disposal by Prof. Mott was measured between 2·5° K. and 22° K. in a vacuum calorimeter enclosed in a helium liquefier using the Simon expansion method. The sample was contained in a small copper calorimeter on which were wound heating and thermometer coils of eureka wire, thermal contact between the calorimeter and the palladium being effected by the use of helium gas at a low pressure.

The results showed that the atomic heat of palladium in the region 2·5°–22° K. could be expressed in the form

$$C = 0 \cdot 0000224\ T^3 + 0 \cdot 0031\ T \text{ cal./degree.}$$

The first term represents the component due to the lattice vibrations and corresponds to a Debye characteristic temperature of $\theta = 275°$, while the second term represents the specific heat of the free electrons or positive holes. At 2·5° K. the linear term is about twenty times as great as the $T^3$ term, while the two terms become of equal magnitude at about 12° K. The value of the electronic specific heat is, as predicted by Mott, much higher than for normal metals, and is even greater than that of nickel. The above result is considered from the theoretical point of view in a book on metals by N. F. Mott and H. Jones, to appear shortly.

I should like to thank Prof. F. Simon and Dr. N. Kürti for their advice and assistance in carrying out this determination.

G. L. PICKARD.

Clarendon Laboratory,
Oxford.
June 8.

[1] W. H. Keesom and C. W. Clark, *Physica*, 2, 513 (1935). K. Clusius and J. Goldmann, *Z. phys. Chem.*, B, 31, 256 (1936).
[2] N. F. Mott, *Proc. Roy. Soc.*, A, 152, 42 (1936).
[3] F. Simon, *Z. Elektrochemie*, 34, 530 (1928).

## Transparency of Sodium and Potassium Films in the Schumann Region

THE remarkable transparency of alkali metal films reported by R. W. Wood[1] is of considerable interest, on one hand in relation to the theory of electrons in metals and on the other in relation to spectroscopic technique, for these films are unique as filters[2].

We have recently succeeded in depositing transparent films of sodium and potassium on fluorite cooled to liquid air temperature before the slit of a vacuum spectrograph. Photographs of the spectrum of the transmitted light establish that not only does sodium transmit from 2100 A. to 1860 A., as observed by Wood, but also that it transmits through the entire Schumann region to 1250 A. (limit of fluorite). Experiments made with different film thicknesses indicate that there is some absorption in the neighbourhood of 1250–1400 A., and it seems reasonable to anticipate that the transparency of sodium does not extend very far beyond 10 volts. For potassium films (which transmit wave-lengths less than 3150 A.) there is no observable transmission beyond 1400 A., while there is evidence of weak absorption extending to between 1700 A. and 1800 A. Examples of the spectra are shown in Fig. 1.

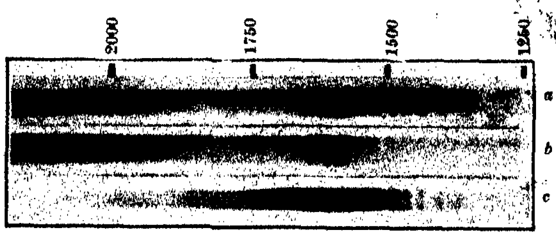


FIG. 1. Transmission of fluorite (a) without metal film, (b) with potassium film, (c) with sodium film.

A sodium film on fluorite is therefore an ideal filter to remove all visible and ultra-violet light of wave-length greater than 2100 A. and to pass the entire Schumann region. A full account of our experiments will be published later, but it is appropriate now to indicate the conflict of the experimental results with the existing theory of the optical properties of metals[3]. According to Wilson's formulæ,

(i) for body-centred cubic lattices the absorption bands overlap and there is no transparency;

(ii) there is a *sharp* rise in the absorption at the low frequency end of an absorption band and slow decrease at the high frequency end.

Both of these conclusions are at variance with the experiments, so the theory cannot be applied in its present form to describe the optical properties of the alkali metals, which ought to afford the most favourable case for the quasi-free-electron model.

One of us (D. G. H.) is indebted to the National Research Council of Canada for scholarships to carry out this work.

W. H. WATSON.
D. G. HURST.

McGill University,
Montreal.
May 5.

[1] R. W. Wood, *Phys. Rev.*, 44, 353 (1933).
[2] H. M. O'Bryan, *Rev. Sci. Inst.*, 6, 328 (1935).
[3] See, for example, A. H. Wilson, *Proc. Roy. Soc.*, A, 151, 280 (1935).

## High Potassium Diet and the Survival of Adrenalectomized Rats

WHILE investigating the factors influencing the length of survival of rats after adrenalectomy, we found[1] that rats receiving liberal quantities of bread as a supplement to their usual diet lived many times longer than the controls fed on the stock ration alone. That this was only partly due to the high sodium chloride content of the bread (8 per cent by dry weight) seemed evident from the still markedly prolonged survival of rats receiving bread with a sodium chloride content as low as the stock diet, namely, 1 per cent. This diet, containing cereals, meat, molasses and vitamins (Purina Dog Chow), was taken well by unoperated animals. After adrenalectomy, however, the rats soon manifested an almost complete anorexia for the Purina, but those with access to bread in addition ate this well almost until the time of death. Consequently, these animals ingested more sodium chloride and a greater number of calories than the rats on Purina alone—facts favouring survival.

In explanation of the preference shown by the rats for bread, we suggested that this being a low residue food did not impair the characteristically diminished appetite of the adrenalectomized rat as did the high residue Purina. The fact that bread is a high carbohydrate food we emphasized as important in view of the well-known breakdown in carbohydrate metabolism in adrenal insufficiency.

Recent work of Zwemer and Truszkowski[2] and also Allers, Nilson and Kendall[3] appears to be of importance in the interpretation of our results. These workers have shown that a high potassium intake is detrimental to the life of adrenalectomized animals. In view of this finding, we have analyzed our diet and found the potassium content of the Purina to be 0·46 grams per cent, while that of the make of bread chiefly used was but 0·135 grams per cent. This result indicates that the low potassium content of the bread may have been a factor favouring survival in our rats so fed. Experiments are in progress to determine the relative importance of these factors.

R. A. CLEGHORN.
G. A. MCVICAR.

Department of Medicine,
University of Toronto,
Toronto.

[1] R. A. Cleghorn, S. M. M. Cleghorn, M. G. Forster and G. A. McVicar, *J. Physiol.*, 86, 229 (1936).
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## Humidity and Insect Metabolism

ENTOMOLOGISTS have suggested that certain insects may show a greater rate of metabolism in dry air than in moist at the same temperature. They believe that such increased metabolism should cause a greater production of metabolic water, to compensate for evaporation from the insect's body, and maintain a constant ratio of water to dry matter at different atmospheric humidities. This increase in metabolic rate is assumed to occur in resting insects which are not moving actively. Buxton[1] obtained results which indicated that, at 23° C., the mealworm used up its reserves more rapidly in dry air than in moist, and kept the ratio of water to dry matter constant. As the body composition of mealworms is so variable, and as these results were obtained from rather small

numbers, it appeared advisable to make further experiments before finally accepting a conclusion of such general physiological importance.

Numerous experiments were made, in which large numbers of individual mealworms were subjected to various humidities at temperatures ranging from 8° to 37° C.[3] Analyses after intervals of from 14 to 35 days showed that the rate at which the reserves were utilized was governed by temperature alone. For example, batches of these insects consumed reserves equal to 19 per cent of their dry weight in 35 days, when exposed to humidities of either 0 or 60 per cent at 24° C. I also made daily estimations of the amount of carbon dioxide produced by mealworms at different temperatures and humidities, and found that the rate of respiration appeared to be governed by temperature alone, and unaffected by changing humidity.

Experiments with other insects, including bed-bugs[4], clothes-moths[5] and adult[6] and pupal[2] tsetse flies all show that with them the rate of metabolism is governed by temperature, and unaffected by changes in humidity.

In the light of present knowledge, it is difficult to see how an increase in the rate of metabolism *could* help an insect to withstand desiccating conditions. True, it would produce more water of metabolism, but this would mean an increase in the rate of respiration (to obtain the extra oxygen) and consequently the spiracles would be opened more frequently. This would allow more water to be evaporated[7]. For every molecule of metabolic water produced, at least one molecule of oxygen must be taken in, and under dry conditions more water is lost by the evaporation which accompanies respiration than is gained by metabolism. This has been shown by analyzing insects which have been subjected to low humidities, and by the fact that many insects are more susceptible to desiccation at high temperatures (where metabolism *is* actually increased) than at low temperatures.

With an actively moving insect, an unfavourably low humidity may perhaps cause great activity, and a consequent increase in the metabolic rate; but this will hinder, rather than help in withstanding desiccation. With resting insects such as fasting mealworms, a lowering of the humidity does not increase the rate of metabolism; if the metabolic rate were increased, it would not be of any advantage.

KENNETH MELLANBY.

Department of Entomology,
London School of Hygiene and
Tropical Medicine.

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[2] Buxton, P. A. and Lewis, D. J., *Phil. Trans. Roy. Soc. Lond.*, B, **224**, 175–240 (1934).
[3] Mellanby, K., *Proc. Roy. Soc.*, B, **111**, 376–390 (1932).
[4] *Parasitology*, **27**, 111–22 (1935).
[5] *Ann. App. Biol.*, **21**, 476–482 (1934).
[6] *Bull. Ent. Res.* (in press) (1936).
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## Organizers in Mammalian Development

EMBRYONIC organizers, discovered in the Amphibia by Spemann[1], have since been found also in birds (Waddington[2]) and fish (Luther, Oppenheimer[3]). It seems probable that embryonic determination is brought about in the same way in all groups of vertebrates, and rather similar conditions have been found in some invertebrates. Previous work on mammalian embryos has, however, produced very little definite evidence in support of this suggestion. The occurrence of identical twins shows that regulation is possible in very early stages (see Nicholas[4]), while several authors have described apparently mosaic development of parts isolated from early somite, or later, stages.

The only available fact concerning the actual process of determination in mammalian embryos is that the ectoderm of the rabbit embryo in the primitive streak stage can be induced, by a chick organizer, to form neural tissue (Waddington[5], working with the tissue culture technique[6]). Attempts to obtain inductions by transplanting pieces of the rabbit primitive streak into other rabbit embryos have so far been unsuccessful, although the grafts differentiate into neural tissue and (probably somitic) mesoderm; small amounts of neural tissue have been found in grafts which did not include the anterior end of the primitive streak, the rabbit behaving in this respect exactly as does the chick.

Grafts may also be made from the rabbit into the chick, and the grafted tissues differentiate (Waddington and Waterman[6]). Until recently, no inductions were observed in these grafts, but this long-expected result has now occurred; in a specimen, No. 36—9ORC, the anterior part of the embryonic axis of a two somite rabbit has induced a small but definite neural plate in the host chick. This shows that the rabbit contains an organization centre, and, taken with the fact mentioned above that the rabbit ectoderm is competent to react to a chick organizer, scarcely leaves room for doubt that the determination of the mammalian embryo during normal development is in fact produced by an organization centre.

C. H. WADDINGTON.

Strangeways Research Laboratory
and Department of
Experimental Zoology,
Cambridge. June 30.

[1] H. Spemann, *Arch. Entw-mech.*, **43**, 448 (1918).
[2] C. H. Waddington, NATURE, **125**, 924 (1930); *Phil. Trans. Roy. Soc.*, B, **221**, 179 (1932).
[3] W. Luther, *Biol. Centralbl.*, **55**, 114 (1935). Oppenheimer, *Proc. Nat. Acad. Sci.*, **20**, 536 (1934); *Proc. Soc. Exp. Biol. and Med.*, **31**, 1123 (1934)
[4] J. S. Nicholas, *Anat. Rec.*, **55**, 31 (1933).
[5] C. H. Waddington, *J. Exp. Biol.*, **11**, 224 (1934).
[6] C. H. Waddington and A. J. Waterman, *J. Anat.*, **67**, 356 (1933).

## Metabolism of Cartilage

THE recent letter of Bywaters[1] on this subject prompts us to describe some observations made independently in the course of a study of normal mammalian tissues showing an anærobic type of metabolism. Following our investigation of the metabolism of the medulla of kidney[2], a tissue recognized as having a poor capillary supply, we were led to study cartilage because this is an entirely non-vascularized tissue, and here we found the same association of anærobic type of metabolism and poor oxygen supply as in medulla of kidney.

Our experiments were done with thinly sliced rib cartilage of the rat, suspended in a bicarbonate-saline medium. Concentration of glucose: 0·2 per cent.

| Material | Respiration | Ærobic glycolysis | Anærobic glycolysis |
|---|---|---|---|
| | $Q_{O_2}$ | $Q_G^{O_2}$ | $Q_G^{N_2}$ |
| Costal cartilage | | | |
| Specimen I | − 0·68 | + 1·22 | + 1·36 |
| Specimen II | − 0·22 | + 1·27 | + 1·85 |
| Xiphisternum | — | — | + 0·90 |

These figures are much higher than those obtained by Bywaters for the rabbit; in particular, the

respiration though small is easily measurable. Comparing the ratios of respiration, ærobic and anærobic glycolysis, we find roughly the same relationship for medulla of kidney, cartilage and tumours.

| Approximate ratio | $Q_{O_2} : Q_G^{O_2} : Q_G^{N_2}$ |
|---|---|
| Medulla of kidney | 1 : 2 : 4 |
| Cartilage | 1 : 3 : 4 |
| Tumours | 1 : 2 : 4 |

Thus cartilage gives further support to the view previously expressed[2] that the metabolic type depends on the relationship between oxygen supply and energy requirements of the tissue.

F. DICKENS.
H. WEIL-MALHERBE.

Cancer Research Institute,
North of England Council of the
British Empire Cancer Campaign,
Royal Victoria Infirmary,
Newcastle on Tyne. July 3.

[1] Bywaters, NATURE, **138**, 30 (1936).
[2] Dickens and Weil-Malherbe, *Biochem. J.*, **30**, 659 (1936).

## Optical Polarization Ellipsoids of the Hydrogen Halide Gases

ESTIMATES of polarization and related constants of the four hydrogen halides[1] appear to reveal certain peculiar, though simple relations. If $\alpha$ is the mean optical polarizability of a halide HX, $b_1$, $b_2$ respectively that along and perpendicular to the internuclear axis of symmetry $S$, $r_e$ the equilibrium internuclear distance of HX, and $\alpha(X)$ the polarisability of the negative ion $X^-$, I find that (1) $\alpha = 1{\cdot}242 r_e^3$ [2,3] and, further, if (2) $b_1 \propto r_e^3$, then since $3\alpha = b_1 + 2b_2$, (2a) $b_2 \propto r_e^3$, (2b) $b_1 \propto b_2$, and (2c) $b_1 = \alpha(X)$ (Born and Heisenberg[4]).

Stuart[5], arguing from the positive sign of the constant occurring in the electro-optical Kerr effect of hydrogen chloride, found that the direction of greatest polarisability $b_1$ coincided with the axis $S$, along which the permanent dipole also lies. If we take[1] $\alpha(\mathrm{HCl}) = 2{\cdot}56$, and[5] $(b_1 - b_2)_{\mathrm{HCl}} = 0{\cdot}77 \times 10^{-24}$ c.c., it follows that $b_1$, $b_2$ are $3{\cdot}07$ and $2{\cdot}30 \times 10^{-24}$ c.c. respectively. Using the above assumption (2), the corresponding values for the other halides may be calculated, as in the following scheme.

| HX | $b_1$, $b_2$, $\frac{1}{3}(b_1 + 2b_2)$ (in c.c. $\times 10^{24}$) | | | $\alpha$(HX) (expt.[1]) | $\alpha$(X) [4] | $r_e$ |
|---|---|---|---|---|---|---|
| HF | 0·96 | 0·72 | 0·82 | 0·80 | 0·99 | 0·864A. |
| HCl | 3·07 | 2·30 | 2·56 | 2·56 | 3·05 | 1·272 |
| HBr | 4·19 | 3·14 | 3·49 | 3·49 | 4·17 | 1·411 |
| HI | 6·24 | 4·68 | 5·20 | 5·18 | 6·28 | 1·612 |

The anisotropy $\delta$ is connected with the depolarization factor $\Delta$ (ratio of light intensity scattered parallel and at right angles to direction of incident beam) for gas molecules having an axis of symmetry, as follows:

$$\delta^2 = \frac{5\ \Delta}{6 - 7\ \Delta} = \left(\frac{b_1 - b_2}{b_1 + 2b_2}\right)^2 = \frac{1}{9}\left(\frac{b_1 - b_2}{\alpha}\right)^2,$$

so that we have $\delta^2 = 0{\cdot}01007$, $\delta = 0{\cdot}1004$ and $\Delta = 0{\cdot}0119$ for each of the four cases. (Stuart[5] found $\Delta(\mathrm{HCl}) = 0{\cdot}0125$, giving $b_1 = 3{\cdot}01$, $b_2 = 2{\cdot}24 \times 10^{-24}$ c.c.)

If we may take $\delta = 0{\cdot}1$, we have $10(b_1 - b_2) = b_1 + 2b_2$, whence $b_2/b_1 = 0{\cdot}75$, $b_1 = 1{\cdot}2\alpha = 1{\cdot}490 r_e^3$, $b_2 = 0{\cdot}9\alpha = 1{\cdot}117 r_e^3$, and $b_1 - b_2 = 0{\cdot}3\alpha$.

On the present basis of argument, therefore, I conclude that (1) the four hydrogen halides have equal optical anisotropies, (2) the optical polarization ellipsoids constitute similar solid figures, (3) $b_2$ is approximately equal to 75 per cent of $b_1$, and (4) $b_1$ of HX is equal to the polarizability of the halogen ion $X^-$, a somewhat surprising result. Dispersion of refractive index is neglected in making the estimates.

Further work on the depolarization and Kerr effects of the hydrogen halides other than hydrogen chloride is desirable to confirm these predictions.

C. H. DOUGLAS CLARK.
Department of Inorganic Chemistry,
University, Leeds.
June 3.

[1] C. H. Douglas Clark, *Trans. Faraday Soc.*, **31**, 585 (1935) (where $\alpha''$ = present $\alpha$).
[2] Clark, *Phil. Mag.*, (vii.), **19**, 476 (1935).
[3] Clark, *Proc. Leeds Phil. Soc.*, **3**, 208 (1936).
[4] M. Born and W. Heisenberg, *Z. Phys.*, **23**, 388 (1924).
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## Focal Depth of the Hawke's Bay Earthquake of February 2–3, 1931

IN the seismological report of the Hawke's Bay earthquake of February 2–3, 1931[1], an attempt was made to arrive at a value for the focal depth of the shock. The method used was similar to that developed by Jeffreys[2] for near earthquakes in western Europe, depending on the apparent delay of the surface wave *Pg*. In the Hawke's Bay earthquake, a phase agreeing reasonably well in velocity with *Pg* was observed on the seismograms at Arapuni, Takaka and Wellington, and the mean apparent delay led to a focal depth of 13 miles (21 km.). On account of the confused nature of the Wellington and Arapuni records, and the lack of precise time on most of the records, it was considered that a definite value for the depth could not be obtained, but that it probably lay between 10 miles and 15 miles (16–24 km.). In the original interpretation of the Takaka record, the first phase recorded after *Pn* was considered to be *P**, and the interval between *Pn* and *Pg* was 28 seconds.

In a recent paper[3], C. G. Dahm, of Saint Louis, U.S.A., had occasion to discuss the focal depth of the Hawke's Bay earthquake, using data from the Takaka seismogram. He found an interval of 7·5 sec. between what he considered to be the phases *Pn* and $\bar{P}$, and states that this agrees with a focal depth of 10 km. (6 miles). Dahm points out that the Takaka data are not conclusive, and after some further considerations, finally arrives at a focal depth of the order of 10–12 km. (6–8 miles).

Having rightly directed attention to the difference between his own value for the depth and that given in the Hawke's Bay earthquake report, Dahm criticises this report, considering that the methods used appear to be based on doubtful assumptions. In view of this criticism, I re-examined the original Takaka seismogram. On both horizontal components the first movement (presumably *Pn*) is very small and emergent, and the interval before the arrival of the second phase was found to be 8 sec. on the E–W component, and 11 sec. on the N–S component. This discrepancy of 3 sec. may be due to the arrival of *Pn* not having been recorded on the E–W component. On the vertical component, *Pn* is very small, but the interval to the next phase was observed to be about 10 sec. The mean interval between *Pn* and the next phase at Takaka therefore appears to

have been of the order of 10 sec. No phase could be found to correspond with an interval of 7·5 sec., as read by Dahm, and if it is assumed that the second phase is $\overline{P}$, then a focal depth somewhat greater than 10 km. is indicated. This would tend to diminish the discrepancy between Dahm's determination of the focal depth, and that given in the Hawke's Bay earthquake report.

It should be mentioned that the re-examination of the Takaka seismogram did not appear to warrant any serious alterations to the original interpretation from which the focal depth of 10–15 miles (16–24 km.) was determined. Further, although Jeffreys' theory regarding the waves in near earthquakes has been somewhat modified in a more recent paper[4], the apparent delay of the *Pg* wave would still lead to a determination of focal depth.

From the foregoing statements, it is considered that Dahm's interpretation of the Takaka seismogram is open to question, and that his criticism of the Hawke's Bay earthquake report is not justified.

R. C. HAYES.

Dominion Observatory,
Wellington, N.Z.
April 24.

[1] C. E. Adams, M. A. F. Barnett and R. C. Hayes, Seismological Report of the Hawke's Bay Earthquake of 1931, February 2–3. Dominion Observatory Bulletin 85.

[2] H. Jeffreys, "The Earth". 2nd Edition.

[3] Cornelius G. Dahm, "The Velocity of *P* waves in the Earth Calculated from the Macelwane *P* curve, 1933", *Bull. Seis. Soc. America*, 26, 1 (1936).

[4] H. Jeffreys, "A Rediscussion of Some Near Earthquakes", *Geophys. Supp., Mon. Not. Roy. Ast. Soc.*, 3, No. 3, March 1933.

## Continuous Spectra of Certain Types of Stars and Nebulæ

MR. W. M. H. GREAVES[1] has made certain objections to my tentative explanation of secondary maxima in the continuous spectra of novæ, etc.[2], because the observations of Nova Herculis 1934 made by various observers do not fully agree.

I should like to point out that a close inspection of the curves given by Beileke and Hachenberg[3] discloses, however, the presence of a secondary maximum in most curves at practically the same wave-length as observed by Barbier, Chalonge and Vasy[4] and reproduced in my note. The results of the unpublished Greenwich observations are, of course, unknown here.

However, leaving aside the Nova Herculis 1934 spectrum, we find, in the spectra of several former novæ, the presence of secondary maxima upon which I based my theory of two different types of continuous emission spectra in novæ, etc., superimposed on each other. Whether or not one of these emissions is continuous electron radiation is an open question. I only wish to direct attention to this type of emission, the existence of which does not seem to be generally realized. This type of spectra is quite different from the Planck black body radiation on which most astrophysical theories are based. I believe that the continuous electron emission will help in explaining several phenomena observed which have not been accounted for so far.

WILLI M. COHN.

Berkeley, California.
May 26.

[1] W. M. H. Greaves, NATURE, 137, 405 (1936).

[2] W. M. Cohn, NATURE, 137, 150 (1936).

[3] F. Beileke and O. Hachenberg, *Z. Astrophys.*, 10, 366 (1935).

[4] D. Barbier, D. Chalonge, E. Vasy, *C.R.*, 201, 128 (1935).

## The Teaching of Science in Schools

AN account of a conference on general science opened by the president of the Royal Society appeared in NATURE of April 11, p. 626. This association of prominent men of science with secondary education is very desirable. I write to suggest that the present is a very critical time for science teaching in schools, and that men of science may now be able to give help in a more effective way than by presiding at meetings and conferences.

Such help has been given in the past. In 1918 a committee of which Sir J. J. Thomson was chairman issued a report on the teaching of science and made many valuable suggestions. A few of these have been carried out, but only a few; in the meantime, conditions have altered, and the whole question needs reconsideration. The recent conference represents a belated attempt to implement recommendation No. 17 of that report:

"That the science work for pupils under 16 should include, besides physics and chemistry, some study of plant and animal life."

To do this in the limited time at the teacher's disposal presents difficulties, but this recommendation must necessarily be read in conjunction with recommendation No. 8:

"That in all secondary schools for boys the time given to science should not be less than 4 periods in the first year of the course from 12 to 16, and not less than 6 periods in the three ensuing years."

This was published nearly twenty years ago, when the great necessity was to obtain for science some sort of recognition in our educational system. It would be expected that what was recommended then would be axiomatic now. Surprising as it may appear, the very body which was partly responsible for this recent conference expressed the intention of trying to formulate a generalized course in chemistry, physics and biology to occupy only 4 periods a week; that is, 3 hours or a little less.

If this proposal comes into being, we shall be back again in pre-scientific times. If I read the recommendation of the Thomson committee aright, it did not maintain that the 6 periods a week was an adequate time, but merely that it was as much as many schools under present conditions could be expected to give. A considerable number of schools have now approximately that time. There is a danger that the publicity which has been given to a particular sub-committee may lead to reduction of this inadequate minimum of time which many science teachers already have.

The whole problem of the school time-table is now in hopeless confusion. No attempt is being made, for example, to correlate the mathematics and the science in the manner suggested by the Thomson committee. Teachers of mathematics and science scrupulously respect each others' territory. The dominant influence is that of a group of headmasters who wish to keep the classical bias of the time-table, and this is probably the origin of the proposal to formulate a scheme for 4 periods a week, a proposal which was originally suggested by the Secondary Schools Examination Council. The time is ripe for another committee, similar to the old Thomson committee, to reconsider the whole question in the light of the conditions of the present day.

H. S. SHELTON.

5 Ferry Road,
Teddington.

### Estimation of Vitamin A

WITH further reference to our letter under this title in NATURE of March 7, p. 402, we have been in touch with Dr. E. M. Nelson, chief of the Vitamin Division, United States Department of Agriculture, Food and Drug Administration, Washington, concerning the ambiguous position of the U.S. Pharmacopœia Reference Cod Liver Oil. Our query was, Are we sure that the "Reference Oil" now in use is identical with the original product ? In reply to our question he has given us permission to publish the following facts, which undoubtedly throw some light on a rather difficult situation :

"There has been only one lot of this reference oil prepared and the samples that have been issued were all bottled at the same time from this lot. Since the potency of 3000 units of vitamin A and 95 units of vitamin D were assigned to this oil, assays have been made at intervals by six laboratories for both its vitamin A and vitamin D content. There has been no indication that the oil has changed in vitamin potency. As soon as the oil was obtained samples were sent to Dr. Charles E. Bills of Mead Johnson and Co., for spectrophotometric determination of vitamin A. He has made several such examinations since that time. His last report was made to the U.S. Pharmacopœia Vitamin Committee on March 24, at which time he stated that as far as can be determined spectrophotometrically the oil has not changed in vitamin A potency."

JOHN F. WARD.
R. T. M. HAINES.

Crookes Laboratories,
London, N.W.10.
June 12.

## Points from Foregoing Letters

THE atomic masses of doubly charged thorium 232, and of uranium 238, have been determined by Prof. A. J. Dempster with the mass-spectrograph, by comparison with the isotopes 116 and 119 of tin (having the same mass-charge ratio). The presence of 0·4 per cent of a stable uranium isotope of mass 235 was also found, and since a radioactive uranium isotope of mass 235 and of half-life 24 hours is already known, Prof. Dempster concludes that the two isotopes, having the same mass and charge, are isomers differing in nuclear properties.

Some previous observations of the conductivity, unimolecular racemization and halogen replacements of alkyl halides in sulphur dioxide and formic acid solution are interpreted by Dr. E. D. Hughes, Prof. C. K. Ingold and A. D. Scott as arising from the slow liberation of a negative halogen ion ($Cl^-$) followed by the rapid elimination of a positive hydrogen ion ($H^+$). The original saturated compound thus becomes unsaturated, as is shown by its subsequent ability to absorb bromine.

A possible chemical mechanism to explain how the addition of sodium sulphide or of certain primary amines helps the removal of hair from hides by fresh lime liquors is suggested by Dr. H. Phillips. These substances reduce the sulphenic acid side-chains to cysteine, and thus prevent the generation of aldehyde groups ; this facilitates the severing of the cystine disulphide cross-linkages of the keratin substance.

From the rate of sedimentation of solutions of thyroglobulin (the active constituent of the thyroid gland) under the influence of strong centrifugal forces, Dr. H. P. Lundgren concludes that it consists mainly of particles of 'molecular' weight 700,000. Low concentration of thyroglobulin or of salts, high temperature, high dielectric constant and *p*H above the isoelectric point have been found to favour the dissociation of thyroglobulin into components of lower particle weight.

The atomic heat of palladium between 2·5° and 22° K. has been determined by G. L. Pickard. He finds, in agreement with Mott's views, that it can be expressed as the sum of two factors, one due to lattice vibrations, which varies with the cube of the temperature, and another, the electronic specific heat, varying directly with the temperature and due to unfilled quantum states (positive holes).

The transparency of thin films of sodium and potassium in the far ultra-violet (Schumann region) has been determined by Prof. W. H. Watson and D. G. Hurst. They point out the value of sodium films as filters to remove the visible and ultra-violet light above 2100 A., and direct attention to the conflict between experimental results and the existing theory of the optical properties of metals.

Rats from which the adrenal body has been removed live longer if fed on bread than when fed on Purina Dog Chow. Dr. R. A. Cleghorn and G. A. McVicar suggest that this is due to the lower potassium content of the bread, since it has been shown that potassium is detrimental to adrenalectomized animals.

By grafting on to chick embryo the anterior part of the embryonic axis of a two somite rabbit, a small but definite neural plate was induced in the host. This, C. H. Waddington states, shows that the rabbit contains an organization centre, and is additional proof that determination of the mammalian embryo is in fact produced by an organization centre.

Dr. C. H. Douglas Clark finds that the optical polarization ellipsoids of the four hydrogen halide gases constitute similar figures having equal anisotropies and depolarization factors. He calculates the polarizabilities for the four cases, and finds that the polarizability at right angles to the internuclear line is about 75 per cent of that along this line, and is equal to the polarizability of the corresponding negative ion.

In view of the divergence in the interpretation of the seismograms of the Hawke's Bay earthquake of 1931 and the calculations of the focal depth therefrom, R. C. Hayes has re-examined the original Takaka seismogram. Its record, he states, confirms in the main the original interpretation, from which a focal depth of 16–24 km. was inferred.

Referring to the note in this column (July 11, p. 81) on "Inactivation of Crystalline Pepsin", Dr. J. Steinhardt states that the fifth-power relation reported in his communication does not extend over the small interval *p*H 6·2–6·45, but from the most acid solutions measured to *p*H 6·45. The velocity interval was over 1 to 5,000, while the smaller interval given in the synopsis is equivalent only to a range of about 1 to 15.

# Research Items

### Actions of Acetylcholine on the Brain

THE pharmacological actions of acetylcholine are of particular interest because, in almost every case in which this substance has been shown to have an action in the body, evidence has been obtained of the presence of a nerve which liberates acetylcholine locally in such a way as to produce this action. Henderson and Wilson have recently filled an important gap in our knowledge of the actions of this substance (*Quart. J. Exp. Physiol.*, **26**, 83; 1936). They have injected acetylcholine into the ventricles of the brain in man. This causes vomiting, intestinal peristalsis and sweating. Its effects on the heart rate, blood pressure, respiration, the pupil, etc., were small and inconstant. The injection of eserine caused similar effects, and potentiated the effect of a later injection of acetylcholine. These effects were produced by comparatively small doses, and it is clear that they were due to a local action on the brain and not to a general action after absorption into the general circulation. Atropine, injected into the ventricles, prevented or abolished the effect. Apart from the interest of the observations themselves, these results are important because they suggest that certain impulses may be transmitted chemically by acetylcholine across synapses in the central nervous system.

### Flour Beetles of the Genus *Tribolium*

THE small beetles of this genus are of great economic importance since they are able to subsist on a wide variety of food materials, and have become widely distributed through commerce. The ease with which they can be reared under controlled environmental conditions has also marked them out as very suitable material for population studies and other kinds of laboratory investigation. In Technical Bulletin No. 498 (March 1936) of the United States Department of Agriculture, Mr. Newell E. Good has brought together a mass of useful information respecting the biology, habits and control of the species of *Tribolium*, together with a selected bibliography of the genus. Keys are given as an aid to the identification of the economically important species, which are also admirably figured. Although primarily written from the economic point of view, the Bulletin will prove useful to laboratory workers also. In the latter connexion, the tabular data respecting development at specified temperatures and on oviposition and longevity may be specially mentioned.

### Spotted Wilt Virus and the Hormone Heteroauxin

WE have received a communication from Dr. B. J. Grieve, of the Department of Botany, University of Melbourne, in which he describes the results of his investigations into the action of the spotted wilt virus upon the growth regulator heteroauxin. It is well known that spotted wilt arrests the growth of infected tomatoes, and it seemed likely that the virus inactivated the growth hormones in these plants. The technique of Went was first used to compare the effects of diseased and healthy juice upon the inward curvature induced by heteroauxin on split pea stems. In four experiments, such curvatures were observed upon the stems placed in healthy juice with heteroauxin, but were absent from those treated with virus juice and the hormone. This seemed to show an inactivation of the growth regulator by the virus, but a further number of similar experiments did not indicate any difference between the two kinds of treatment. Another and more conclusive method of study involved the injection of various amounts of heteroauxin into healthy, and into diseased, tomato plants. Adventitious roots appeared upon the stem in the majority of healthy plants, but did not form upon diseased tomatoes, unless the plant appeared to have thrown off the disease. The inhibitory action of spotted wilt virus on heteroauxin is not shared by two other viruses which were used, namely, tobacco viruses 1 and 6.

### *X*-Chromosome of *Drosophila*

THE *X*-chromosome of *Drosophila melanogaster* and *D. simulans* contains near the end an enlargement or 'bulb' in the salivary gland chromosome, the nature of which has been investigated by Dr. C. A. Offermann (*J. Genetics*, **32**, 103). He finds that the bands run obliquely in two series in the 'bulb', and that it represents a symmetrical duplication or 'branch' of a short chromosome segment. This might arise through three breaks and two re-attachments in a pair of chromosomes, or by five breaks and three re-attachments. In either case, one of the breaks must occur at the same level in both chromatid strands. As the 'bulb' occurs in two closely related species, it must have arisen in their common ancestor and must therefore be a stable feature of the chromosome. This is accounted for by the fact that crossing-over can occur between the two arms of the duplication, the bands of which are in reverse order. The less condensed appearance of the 'bulb' in salivary chromosomes of the male than in the female is attributed to a lesser synaptic attraction between the chromonemata in the male nuclei.

### Strength Tests of Structural Timbers

UNDER this title in *Forest Products Research Records*, No. 8, Part I dealt with general principles, with data on redwood from Gefle and Archangel. Part 2 of the same series (April 1936) deals with general procedure of selecting and testing joists, with data on British Columbian Douglas fir (*Pseudotsuga Douglasii*) by C. J. Chaplin and E. H. Novard. The tests were carried out with small clear specimens and also on a full scale: the results are of considerable interest. In summarizing them, the Director of the Princes Risborough Laboratory says that "A comparison between the results given in this report and those published by the Forest Products Laboratories of Canada may show an apparent discrepancy in the strength values. This is due to difference in the relation between width and depth of cross-section of the pieces tested and to differences in character which may occur between samples of the timber. Such differences in character must be expected where a wide range of the timber is dealt with in the country of origin. The Forest Products Research Laboratory at Princes Risborough accepts completely the validity of the Canadian figures, and urges their use in all circumstances concerning the

strength of Canadian Douglas fir. The same applies to results published by the Forest Products Laboratory at Madison, U.S.A., for Douglas fir grown in that country."

### Experiments with 'Electrets'

A COMMUNICATION entitled "The Disengagement of Energy in Melting Electrets" has been received from Drs. G. Groetzinger and H. Frei, of the University of Vienna. An 'electret' is produced by solidifying certain types of wax, for example, carnauba wax, in a strong electric field. The wax thereby acquires a polarization, in the direction of this applied field, which may be retained unimpaired over very long periods of time. It may be said to be the electrical equivalent of the permanent magnet. A paper by A. Gemant, published in the *Phil. Mag.* (**20**, 929; 1935) describes much research work on the subject, with a bibliography of earlier papers. Drs. Groetzinger and Frei state that, when an electret is melted, the stored charge is released as an electric current, and that this charge is the same whether the electret is melted immediately or several days after its preparation. This, however, is to be expected, since it is known that electrets can retain their original charge for a considerable period. The authors also record that, when the electric field is applied to an already solid sample of the electret material, the stored charge is much less than before, and instead of being retained, as in the normally produced electret, it disappears fairly rapidly. This is quite a normal procedure, and the experimental result is what would naturally be expected.

### Transmutation of Platinum by Deuterons

TRANSMUTATION by bombardment with artificially accelerated deuterons, which is nearly general among the light elements, has now been observed with very heavy elements. J. M. Cork and E. O. Lawrence (*Phys. Rev.*, **49**, 788, June 1) have bombarded platinum foils with deuterons of maximum energy $5 \times 10^6$ volts. The induced radioactivity was composite in character; periods of 28 min., 8·5 hr., 49 min., 14·5 hr. were detected, and a chemical investigation showed that the first two periods were associated with iridium and the second two with platinum. Both positrons and electrons were emitted. The transmutation of such heavy elements is not to be explained on the Gurney-Condon-Gamow theory of the penetration of potential barriers, and the formation of iridium isotopes is not explained by the theory of Oppenheimer and Phillips, in which only the neutron part of the deuteron enters the nucleus. The direct action of secondary neutrons was excluded by a special experiment. The production of iridium isotopes probably follows the entry of deuterons of special velocities into the nucleus by a 'resonance' process, and the dependence of transmutation efficiency on deuteron velocity is in accordance with this view.

### Velocity of Rapid Reactions

SOME years ago, Hartridge and Roughton devised a method for the study of rapid reactions in which two solutions were mixed and then made to flow down a tube. The progress of the reaction at points along this tube was measured by optical methods. The method has now been improved by the use of photo-electric cells and by reducing the scale of the apparatus (F. J. W. Roughton and G. A. Millikan, *Proc. Roy. Soc.*, A, **155**, 885, June 2). The mixing arrangements and the character of the flow down the tube have been specially studied. The smallest apparatus may be used with 20–30 c.c. of fluid to study reactions with half-periods of 0·0005 sec. Some experiments on reactions which have been studied by other methods confirm the validity of the method.

### Low Temperature Carbonization of Coal

THE Department of Scientific and Industrial Research has published the results of tests made in accordance with a standing arrangement by the Director of Fuel Research on a plant erected by the Coal Research Syndicate, Ltd., at Mansfield, for the carbonization of coal at low temperatures (London: H.M. Stationery Office. 9*d.* net). The process has interesting features. A charge of lump coal (35 tons), almost devoid of caking properties, is carbonized in a chamber 10 ft. in diameter and 25 ft. high by the combustion at the top of the column of part of the gas made. The products of combustion and distillation are drawn downwards through the charge, and leave the bottom for the gas treatment plant. A portion of the gas is returned to the top of the carbonization chamber when, as mentioned above, it is burnt after the addition of air. At the end of the carbonization, the bottom of the retort is withdrawn by hydraulic gear, and the whole charge is dropped for quenching. The coke product was found, on test, to be a satisfactory fuel for the open grate. This process is interesting because, unlike most low temperature processes, it handles the material in bulk comparable and exceeding that in modern coke ovens.

### Development of the Coiled-Coil Lamp

IN the *Technical Review* of April published by the Philips Laboratory, Eindhoven, Holland, there is an instructive paper by W. Geiss on the development of the coiled-coil lamp. The first material used for lamp filaments was carbon and later graphite. A further increase in temperature was made possible by the adoption of metals with high fusion points like osmium, tantalum and tungsten. At present, tungsten is considered the best material for lamp filaments. To obtain a high efficiency, it is essential to keep the rate of volatilization as low as possible. A 'filling' of argon or nitrogen at 50–100 cm. pressure greatly diminishes the rate of volatilization. Unfortunately, the gas filling increases the losses by thermal conduction and convection. In this respect thick filaments give much more satisfactory results than thin ones. If a long thin filament is wound in the form of a spiral, its total heat losses are of the same order as for a filament of the same length and cross-section as the spiral. It has been found possible to reduce the effective length of the coil still farther by winding the coil itself round a core, and this gives the 'coiled-coil' arrangement. The first attempts to use coiled coils were made twenty years ago, and failed mainly because the filaments expanded during service. By suitable pre-treatment, this difficulty was overcome. A mixture of argon and nitrogen has been used for filling these lamps. If krypton or xenon were used as a filling, the heat losses would be greatly diminished. Whether they will ever be used depends on the progress that is made in isolating these rare gases. If the flux from a single-coiled and a coiled-coil lamp is the same, the saving in power in the latter lamp is 7–10 watts; in addition, it maintains its efficiency better during life. The increase in the efficiency obtained by coiling the filaments is more marked for lamps of small candle-power.

# Tercentenary of the University of Utrecht

ON June 22–24, a brilliant sun shone on the ancient and famous city of Utrecht, thronged with students and visitors from many lands and gaily decorated with the national flag of Holland and the colours of all the Faculties. The occasion was the celebration of three hundred years of the University's existence. To Utrecht had come the representatives of most of the universities and learned academies of the world, to pay homage and do honour to her ancient and distinguished university. Amidst the scarlet gowns and many coloured hoods of the professors and academicians flashed the white plumes of the horses and the gay cockades of the splendid coachmen of the students' carriages, for to Utrecht had also come the representatives of the students' "senates" from all the universities of Holland, and the associations and clubs of old University of Utrecht men from every part of the country. In this land won by brave men from the sea, where freedom dwells and learning flourishes, all had met to place another milestone on the long road of civilization, wherewith to mark the completion of the third century of a great university's beneficent life.

During the forenoon of Monday, June 22, the associations and clubs of former members of the University came with their banners in a procession from the station, whilst a great carillon pealed and thundered from the thirteenth century tower of the Cathedral Church. In the afternoon, gifts were presented to the University. At eight o'clock in the evening, the foreign delegates, representing universities and learned academies and societies, were received by the Council and Senate in the great Hall of the University, while at nine o'clock the municipality of Utrecht held a reception in the rooms and beautiful garden of the Municipal Art Gallery.

Serious business began on Tuesday, June 23. In the morning the delegates, in academic robes and decorations, were received by the University in the Church of St. Peter. Addresses of welcome were delivered by Dr. S. Jacob, the President of the Council, and Prof. C. H. Vollgraff, the Rector Magnificus. Speeches of congratulation and thanks were then made by Prof. J. Huizinga, of the University of Leyden, and by several foreign delegates, including Dr. Clarke, of the University of Oxford. The University hymn, "In Babylonia", was played on the viola, with organ accompaniment, by Mrs. Vogelsang. As the name of each delegate was called, he came forward and presented an address of congratulation to the President and the Rector. Then the members of Council, the professors of the University of Utrecht and the foreign delegates walked in procession from the Church of St. Peter to the Cathedral Church, where lunch was provided in the cloisters and the beautiful old cloister garden. Among the other English delegates present may be mentioned Prof. G. Barger (representing the University of Edinburgh), Prof. F. G. Donnan (representing the Royal Society and the University of London), and Prof. D'Arcy Thompson (representing the Royal Society of Edinburgh and the University of St. Andrews).

After lunch, the great procession of professors and delegates walked through the streets of Utrecht, which were thronged by enormous crowds of citizens and guarded by cordons of police. This brilliant and most impressive scene was watched by the Queen of Holland and the Princess Juliana. The procession returned by a different route to the Cathedral Church, where a solemn service of commemoration was held in the presence of the Queen and the Princess, and a great gathering of invited guests, including many high officers of the army and navy and high officials of the State. After some of the beautiful organ music of Bach, addresses were delivered by the President of the Council and the Rector Magnificus, the latter giving a long account of the struggle of Western civilization for freedom of learning and liberal government. Then came a very interesting ceremony, the presentation of the first gold medal of honour of the University to the Queen, to which Her Majesty made a suitable reply of thanks. After some more organ music, a short and eloquent address was delivered by His Excellency the Minister of Education, Art and Science. The proceedings were concluded by the ceremony of attaching the third centenary ring to the pole of the great banner of the University.

After the commemoration service, a number of foreign delegates were presented to the Queen, and as the great procession again filed out of the Cathedral Church, a carillon was played by J. A. H. Wagenaar.

In the evening, a banquet was given by the Senate of the University, at which many delegates made speeches of congratulation and thanks. After the banquet the guests were taken by bus to a wonderful open-air performance by members of the Students' Associations. This was a dramatic pageant entitled "De Groote Geus" (The Great Vagabond). The façade of a great castle had been erected in a large meadow, representing the stronghold of a Spanish noble. In front of this the peasants and citizens held a market fair. Then came the "Groote Geus"—the Dutch Tilleulenspiegel—with his jesters and his jests, to amuse the people and by sarcastic innuendo to arouse them from their bondage. Their anger grew, but Spanish horsemen and men-at-arms poured from the castle gates to quell them. Finally, the Hidalgo with his chatelaine and retinue came out to witness a masque prepared by Tilleulenspiegel. But the people saw what he meant—it was a masquerade of the "Fat- and swollen-headed overlords". In a burst of rage and anger, they stormed and burnt the castle. The drama thus represented the struggle of the Netherlands for freedom from the Spanish yoke. It was a fine performance, played by something like three hundred students, with elegant costumes and elaborate flood-lighting effects. High praise must be accorded, not only to the author, producer and director, but also to the excellent acting and speaking of Tilleulenspiegel, who had a very heavy part. A special and very enjoyable feature of the pageant was the dramatic music, which was played from behind the façade by the municipal orchestra. This music was specially composed for the occasion by Dr. H. E. Enthoven.

The forenoon of Wednesday, June 24, was taken up by the conferring of honorary degrees on a number of delegates in the Great Hall of the University. Among those who were thus honoured may be mentioned Sir Henry Dale, Prof. Herbert Freundlich (University College, London), and Dr. Clarke (University of Oxford). At midday the delegates and their ladies were entertained to lunch in the cloisters and cloister garden of the Cathedral Church, after which they witnessed the march past the University of the students' "Masquerade". This was a dramatic procession of pikemen, mounted knights, etc., of which the special feature was the "Prince of Orange" and his retinue.

In the afternoon, there was a very enjoyable excursion (by autobus) into the province of Utrecht, including a visit to Hilversum and its new town hall (a fine building in the modern unadorned style) and tea in the park of the Chateau Deynselburg, given by Madame and Dr. S. Jacob. On returning to Utrecht, the guests paid homage to the "Prince of Orange", who held a Court.

The day concluded with a gala concert in the Tivoli Concert Hall, conducted by the famous Willem Mengelberg. The programme was: *Sol Justitiae*: a hymn dedicated to the University of Utrecht on the occasion of the third centenary (composed by Dr. H. E. Enthoven); *Piet Hein*: a Dutch rhapsody (composed by Dr. P. G. van Anrooy); Overture to the "Taming of the Shrew" (composed by Dr. Joh. Wagenaar); Beethoven's Fifth Symphony.

The music was well played by the municipal orchestra under the spirited leadership of Mengelberg. An amusing incident was the arrival of the "Prince of Orange" and his retinue. Even the great Mengelberg had to come down from his rostrum and pay homage!

Thus ended three wonderful days of lavish Dutch hospitality, academic ceremony and students' pageantry. As if in remembrance of the University motto, *Sol Justitiae, illustra nos*, the sun shone brightly on the gay scene of scarlet gowns, white-plumed horses, knights on horseback and the great Prince of Orange. The professors of the University amply sustained the honour of their city and their country in offering very kind private hospitality to many of the invited guests.

It was a great demonstration of the universality of learning, of the brotherhood of truth and freedom. As one stood in the peaceful cloister garden and listened to the carillons from the ancient tower, the message of a noble civilization resounded in one's ears. One was glad to feel that Holland had kept the sweet music of her old carillons and in the benign tolerance of a greater humanity had won the freedom of her soul.

F. G. DONNAN.

# Fractures in Metals and Brittle Materials

A DISCUSSION on "Fractures in Metals and Brittle Materials" was held at the Royal Society on Thursday, June 11. Many points of importance were brought out in this interesting discussion, and it is perhaps difficult in the small space of a general article to do justice to them.

In introducing the subject, Dr. H. J. Gough presented a review of the present position of knowledge in regard to the understanding of the mechanism of failure. As regards metals, he holds that in view of their essentially crystalline structure the required physical explanation must be in terms of atomic structure before any real progress in ideas can be achieved. Stripped of non-essentials, the problem is that of obtaining an understanding of plastic deformation and a realization of the exact conditions under which a crack is formed. He emphasized the disability of not having available a satisfactory conception of the laws of cohesion in the metallic state, and the extreme value of any new contribution in this direction. Elasticity is an expected property in a metallic crystalline aggregate, but plasticity is a property which is extremely difficult, at the present time, to understand.

The study of single crystals is very helpful since the processes of deformation and fracture are characteristics associated with the crystal structure, and effects in crystal aggregates are modifications of the effects occurring in single crystals. The geometrical aspects of deformation are established, but give no information on the mechanism of fracture. While stressing the fact that the characteristics of deformation and fracture are probably capable of explanation in terms of single crystals, it must be remembered that the strength of polycrystalline aggregates depends to some extent on crystal size, so that an understanding of the part played by the crystal boundaries is a very important factor in the solution of the whole problem. No established explanation has yet been provided in regard to work-hardening, strain hysteresis, twinning and the process of conversion of strain energy indefinitely into heat energy.

Assuming that the mechanism of fracture is essentially a property of the individual crystals, Gough and Wood have described, in a recent paper, an investigation by X-ray methods into the physical system prevailing after different numbers of cycles in fatigue tests. It would appear that at fracture the physical system is the same under all conditions. Under a safe range of stress the damage to the crystal structure is not progressive, but a stable state is reached, whereas under an unsafe range of stress progressive change takes place. The changes in the neighbourhood of the ultimate fatigue crack are characteristic and exactly similar under all unsafe ranges of stress, and in this area the original structure is destroyed and new crystallites formed. This appears to be a definite advance in knowledge.

Prof. G. I. Taylor confined his remarks chiefly to the more precise mathematical theory of internal flaws. If one crystal is deformed, and hardening is produced in the crystal, additional stresses are imposed on the surrounding crystals, which therefore tend to become deformed. In steel at the yield point the stress is reduced on deformation. In this case the deformation tends to proceed in the same crystal and an irregular deformation results.

If the material has internal flaws—such as might be represented by small spherical and ellipsoidal cavities—the stresses acting locally are increased. Failure under these local stresses would be expected

to occur when certain critical combinations of shear and direct stress are reached. (The exact relationships between shear and direct stress which follows from Mohr's hypothesis and from that of von Mises differ somewhat.) A special case is that where the cavity is filled with a material. For simple shapes of cavity, the stresses can be calculated, and one result is that if a flaw is assumed to be ellipsoidal, then the greatest concentration of stress may occur with the direction of the flaw at 45° or at right angles to the direction of principal stresses, according to the relative compressibility of the 'inclusion'.

Prof. L. N. G. Filon dealt chiefly with the different types of fracture which occur in solids, and illustrated his remarks with a large number of fractures in cast iron and glass. In ductile materials, slip does not always occur at 45° to the principal stresses. A fracture in a strip of mild steel broken in tension showed a fracture at approximately 60° to the line of the principal stresses. This was not due to any assymetrical properties of the steel, since a second slip line clearly shown by the material was exactly symmetrical with the first. In cast iron, brittle fractures can be obtained by a bending operation in which pure tension is applied to some parts of the material, and pure longitudinal compression in other parts. In this case fracture occurs at right angles to the stress lines. A curious 'staircase' fracture has been observed in these brittle materials in which the fracture began at right angles to the tension, but after passing through the material for some distance, branched along the line of tension, and branched back into the original direction and gave a step. In some cases several steps were observed. The conclusion reached was that in the same material the type of fracture obtained depends on the method of application of stress.

The possible effects of sub-microscopic cracks was the chief point discussed by Prof. E. N. da C. Andrade. He considers that the existence of surface cracks has been well established in three series of experiments. A strip of mica loaded so that the edges are stress free has a strength of about ten times the normal value. Andrade and Martindale in experiments on thin metal films on glass, diamond or other substance, have found that recrystallization proceeds on definite lines on the surface. These lines do not appear when the film is produced on the very perfect cleavage faces of mica. Indirect evidence of these surface cracks is afforded by experiments of Roscoe on cadmium wire, which had its critical shear stress increased to double the normal value when coated with a thin film of oxide a few molecules thick. It is well known that freshly drawn threads of quartz and glass are stronger than old threads. Griffiths believes this to be due to the absence of cracks in the freshly formed threads. In concluding, Prof. Andrade indicated briefly some of the difficulties of forming a theory of plastic deformation. In plastic materials, twinning and gliding take place on the twinned material in a way which is very complicated even in single crystals.

Dr. W. H. Hatfield said that the stress which may be safely applied is far removed from the stress which produces fracture, and that from the point of view of the engineer and metallurgist, the actual mechanism of fracture is less important than a satisfactory explanation of the means which are effective in increasing the safe range of stress. In iron, the fatigue range of the crystalline aggregate is increased and the stress to produce initial plastic deformation is also increased by 'sprinkling' particles of a hard, brittle substance, carbide of iron, through the mass of the ductile metal. It requires to be explained how the presence of such carbide particles raises the stress required to produce initial deformation in the continuous matrix of ductile ferrite. An increase in the value for the stress up to which strain is proportional to stress is difficult to understand. Particles of other hard brittle materials such as slags, sulphides, etc., do not have the same effect, in that they leave the yield point and maximum stress unaltered, but the ductility is very much decreased. It seems, therefore, that the adhesion and cohesion between the ductile matter and the particular inclusions is an important factor. An interesting fact which requires explanation is the influence of cold work on the fatigue values. It seems peculiar that a process of plastic deformation should increase the resistance to fracture. Much has been written on the effect of grain size, but it is easy to overlook the fact that to modify grain size as the only variable is extremely difficult, if not impossible. The causes of the modification of grain size may well be the real cause of the apparent effect of grain size.

Prof. P. B. Haigh's contribution was of particular interest in that it could be considered that his observations postulated a resuscitation of the idea of stress in metals translating the crystalline to the amorphous phase. When a slip band is formed in a crystalline ductile metal, the increase in the volume from the crystalline to the amorphous state tends to produce fluid pressure in a core surrounded by increased shear stress, and the band tends to spread across planes of easy cleavage in the grain.

Mr. S. A. Main suggested that more work on the speed of testing and the influence of temperature might lead to further information on the main problem. He also referred to the characteristic appearance of slip bands which are visible under the microscope and are therefore of a different size from Gough's 'crystallites'. There can be little doubt that the characteristic separation of the bands has a fundamental bearing on the problem.

Sir Robert Hadfield, in a written contribution, said that when attending trials of projectiles against modern armour, he had often observed that there seemed to be little difference in the appearance of a fracture, as compared with the fractures met with under ordinary static or dynamic conditions at comparatively low velocities of impact. Nevertheless, there were instances of remarkable differences in behaviour of various steels according to the manner in which they were tested, that is, whether comparatively slowly or rapidly. Some materials like over-heated mild steel, tough under slow stressing, are quite brittle at moderate speeds of testing. Mild steel of ordinary good quality is tough at all normal speeds used in impact testing, but tends to break with a brittle fracture when attacked at high speeds with rifle bullets. With regard to the effect of low temperature, there seems to be no simple explanation of the different responses made by different metals. Thus the retention by nickel of its toughness at very low temperature is not simply explained by its particular type of cubic structure, namely, the face centred cubic, in contrast with that of iron, which is body centred cubic.

The discussion was an extremely valuable one, and has served to indicate many directions in which intensive investigation can usefully proceed.

# Research Fellowships and Grants

## Royal Society Awards

THE Council of the Royal Society decided in the spring of this year to found an E. Alan Johnston and Lawrence research fellowship in medicine by means of funds available to the Society by bequests under these two names. The value of the stipend is £700 per annum, plus superannuation allowance. Seventeen candidates applied for the fellowship and of these, four were selected for special consideration. Council would gladly have appointed any one of them to a fellowship had four fellowships been available. The reception of the fellowship is a strong indication that candidates of high merit are available for full-time research posts in medicine. Council finally selected Dr. John McMichael, of Edinburgh, to work at the Edinburgh Royal Infirmary on the pathology of heart failure. From 1934 to 1936 he has been a lecturer in human physiology at Edinburgh. He has been offered special facilities for his work at the Edinburgh Royal Infirmary.

The Council of the Royal Society has also approved plans for medical research on malaria and on nutrition in India, involving a total expenditure of more than £8,000 in the next five years. Colonel Sinton has been appointed to investigate certain aspects of malaria at the Horton Centre. Another series of investigations on malaria, in conjunction with the London School of Hygiene and Tropical Medicine, provides for a study of mosquitos in the tropics, and Dr. C. Wilson has been offered a research appointment to enable a survey of nutritional conditions in India to be undertaken.

## Leverhulme Fellowships and Grants

Awards of Leverhulme fellowships and grants in aid for research for 1936 have been made to the following, among others, the subject of research being indicated in brackets: Dr. Agnes Arber (studies in the principles of angiospermous morphology and in the history of botany); S. J. Duly, head of the Department for the Scientific Study of Commercial Products, City of London College (carriage of goods by sea); Dr. F. Fairbrother, senior lecturer in chemistry, University of Manchester (the study of electrolytic dissociation processes and the mechanisms of chemical reactions by the use of induced radioactivity); C. P. Fitzgerald (sociology of the non-Chinese tribes of Yunnan, S.W. China); S. D. Garrett, formerly assistant plant pathologist, Waite Agricultural Research Institute, University of Adelaide, South Australia (biological antagonism of the soil microflora towards root disease fungi or crop plants—renewal of present fellowship); Dr. J. de Graaff Hunter, lately director of the Survey of India (planning and execution of geodetic triangulation of great extent); Mrs. K. Lonsdale, research worker, Royal Institution (relation between structure and physical properties of organic molecules—renewal of present fellowship); E. P. Mumford, lately director of the Pacific Entomological Survey, Honolulu (terrestrial and freshwater biota of the Marquesas Islands—renewal of present fellowship); F. R. Perry, member of Research Department, Metropolitan-Vickers Electrical Co., Ltd., Manchester (the study of overvoltages due to lightning on transmission lines—renewal of present fellowship); Dr. A. L. Reimann, research physicist, General Electric Company, Limited, Wembley, Middlesex (electronic conduction phenomena in solid insulators and semi-conductors); Dr. R. H. Thouless, head of the Department of Psychology, University of Glasgow (research in visual perception); Dr. W. E. Williams, lecturer in physics, King's College, London (determination of the vacuum wave-lengths and the structures of spectral lines by means of his reflection échelon).

Grants in aid of research have been made to the following: Prof. A. E. Boycott, late Graham professor of pathology, University of London (ecology and genetics of British non-marine Mollusca); Prof. H. J. Fleure, professor of geography, University of Manchester (physical (racial) characteristics of the peoples of Wales); Prof. J. W. Heslop Harrison, professor of botany, Armstrong College, Newcastle-on-Tyne (researches on evolution and heredity—renewal of present grant); T. N. Hoblyn, statistician, East Malling Research Station, Kent (technical problems in the layout and conduct of horticultural field experiments under tropical and sub-tropical conditions); Dr. W. H. Pearsall, reader in botany, University of Leeds (growth of Algæ); Dr. O. W. Richards, lecturer in entomology, Imperial College of Science and Technology, London (habits of South American bees and wasps); Prof. C. W. Valentine, professor of education, University of Birmingham (psychology of early childhood). A Leverhulme travelling fellowship has been awarded to Mr. A. Ruscoe Clarke on the nomination of the Medical Research Council.

Particulars of these awards can be obtained from the Secretary, Leverhulme Research Fellowships, Union House, St. Martins-le-Grand, London, E.C.1.

## Beit Memorial Fellowships

The trustees of the Beit Memorial fellowships for medical research have made the following awards, the subject and place of research being given after the name of each new fellow: *Fourth Year Fellowships* (£500 a year): Dr. E. S. Horning, to continue his research on the cancer-producing effects of œstrogenic compounds, and on the possibility of producing tumours *in vitro* (Imperial Cancer Research Fund, Queen Square, London); Dr. W. J. Dann, to continue his work on the vitamin $B_2$ complex in reference to the treatment of pellagra (Duke University School of Medicine, North Carolina, U.S.A.). *Junior Fellowships* (£400 a year): Dr. I. Berenblum, to study the mechanism of skin irritation by chemical substances in reference to their action as exciting or preventing the development of cancer (Dunn School of Pathology, University of Oxford); D. D. Woods, to study the metabolism of the anaerobic bacteria, and the phenomenon of adaptation in bacteria (Dunn Institute of Biochemistry, University of Cambridge); Dr. A. Neuberger, to study the carbohydrate group in proteins and its possible relationship to their antigenic properties in bacterial immunity (Department

of Pathological Chemistry, University College Hospital Medical School, London); C. W. Bellerby, to investigate the control of the reproductive cycle by the anterior lobe of the pituitary (Department of Social Biology, University of London); Dr. T. W. Birch, to attempt to identify the component parts of the vitamin $B_2$ complex (Nutritional Laboratory, Cambridge); Lilian M. Pickford, to study the part played by the posterior pituitary gland in the control of water excretion by the kidneys (Pharmacological Laboratory, University of Cambridge); Dr. R. J. Pumphrey, to investigate the sensory physiology of insects, and the electrical response in the central nervous system to peripheral stimulation of afferent nerves (Zoological Laboratory, University of Cambridge); T. A. H. Munro, to study the role of inheritance in mental disorder (Research Department, Royal Eastern Counties Institution, Colchester).

### AWARDS OF ROYAL COMMISSION FOR THE EXHIBITION OF 1851

The Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 announces the following appointments for 1936: *Senior Studentships:* Dr. R. C. L. Bosworth, for research in chemical physics at Cambridge; N. A. Burges, for research in mycology at Cambridge and the Strangeways Research Laboratory, Cambridge; T. T. Paterson, for research in geology and prehistory at Cambridge; A. F. Rawdon-Smith, for research in physiology and psychology at Cambridge; Dr. D. Shoenberg, for research in physics at Cambridge. All the above awards were made on the recommendation of the University of Cambridge. *Overseas Scholarships:* D. G. Hurst, for research in physics at the Universities of California and Cambridge; J. Marsden, for research in physical chemistry at the University of Cambridge; on the recommendation of McGill University, Montreal. A. D. Misener, for research in physics at the University of Oxford or Cambridge; S. L. Cohen, for research in biochemistry at the Technische Hochschule, Zurich; on the recommendation of the University of Toronto. H. C. Corben, for research in theoretical physics at the University of Cambridge; on the recommendation of the University of Melbourne. R. N. Robertson, for research in botany at the University of Cambridge; on the recommendation of the University of Sydney. I. E. Coop, for research in physical chemistry at the University of Oxford; on the recommendation of the University of New Zealand. Dr. B. G. Shapiro, for research in biochemistry at King's College Hospital, London; on the recommendation of the University of Cape Town. C. O'Kelly, for research in experimental physics at the University of Cambridge; on the recommendation of the National University of Ireland.

### SALTERS' INSTITUTE AWARDS

The following awards for 1936–37 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company: Fellowships renewed to: E. I. Akeroyd, Emmanuel College, Cambridge; L. R. Barrett, Lincoln College, Oxford; T. K. Hanson, Oriel College, Oxford; and C. S. Windebank, University of London. Fellowships awarded to: L. M. Baxt, King's College, London; and T. A. Dent, St. Catharine's College, Cambridge. The Institute has also awarded 150 grants-in-aid to young men and women employed in chemical works to facilitate their further studies.

### MEDICAL RESEARCH COUNCIL AWARDS

The Medical Research Council announces the following awards of travelling fellowships for the academic year 1936–37: *Medical Research Council fellowships in medical science:* J. T. Chesterman, H. E. Holling. *Dorothy Temple Cross Research fellowships in tuberculosis:* A. L. Jacobs, J. Smart, Dr. B. C. Thompson, V. C. Thompson. *Rockefeller fellowship in psychiatry:* Dr. J. H. Quastel.

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# Excavations at Tell Duweir, Palestine, 1935-36

AN exhibition of antiquities from Tell Duweir, the ancient Lachish, which have been obtained by the fourth expedition of the Wellcome Archæological Research Expedition to the Near East in 1935–36, opened at the Wellcome Research Institute, Euston Road, London, N.W.1, on July 9 and will remain open until the end of the month.

The excavations, which again were under the field direction of Mr. J. L. Starkey, were mainly directed to completing the clearance of a number of areas attacked in the course of previous seasons' work; but nevertheless, material of considerable archæological interest and importance was obtained. An interesting group of bronze objects, much crushed, came from a quarry on the saddle, which had partially collapsed in ancient times. These objects date from the early Middle Bronze Age of pre-Hyksos times, and among them were a kohl stick and mirror, of which the latter is the first example to be found at Tell Duweir.

A further clearance of the temple and its superimposed reconstructions made it clear that the essential plan of all three structures was identical, but that there had been a great expansion in the second temple. Further evidence was obtained pointing to the temple having been the seat of the cult of a triad of deities, of which one was female, and of affinities with the north. Below the floor of the second temple, a mass of pottery was found under the altar bench, which included a Late Helladic II goblet, dating at about 1450–1400 B.C. It is of buff paste with cream slip and has a painted band decoration showing an ivy leaf motif. This, from the point of view of the archæologist, is one of the most important finds of the season, as it dates more or less accurately, and links up a number of Palestinian finds.

Two sides, measuring eighty-five and seventy-five feet respectively, of a remarkable opening, apparently the entrance to a subterranean tunnel, have been cleared; and a clearance within the gate has revealed under the Persian level what was apparently the

commercial quarter, with shops of a wine or oil seller, corn chandler and a weaver containing many of the appurtenances of their trades.

What proved, however, to be the most extensive and, in some ways, the most important discovery of the season, was made in the western valley in continuation of work begun two years ago. Here in a little-disturbed, small circular tomb lined with plaster was a collection of objects in number such as is rarely found in so small a space. From this were taken two hundred pots, of which fifty-three were types new to Tell Duweir. The most interesting was a censer, which in paste and finish recalls the famous Tell Duweir ewer on which was the inscription in the early Palestinian alphabetic script. This censer has lugs and a flat cover, on the upper side of which is an incised decoration with tree or plant motif in a hatched border, and on the under side a further example of the early script.

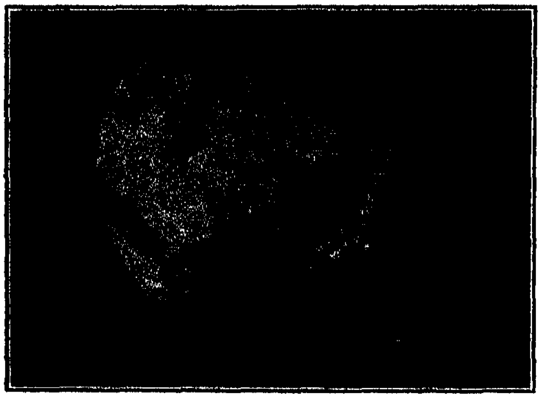

*Photo* *Ralph Richmond Brown*

FIG. 1. Artificially deformed skull from Tell Duweir. By courtesy of the Wellcome Archæological Research Expedition to the Near East.

The tomb itself, as is shown by a number of scarabs, dates from 1400 to 1300 B.C. or even 1275 B.C. Among the objects found are a long-tanged bronze dagger of Eighteenth Dynasty type, bronze lance and sporting arrow heads, and faience draughtsmen with plaques from the gaming board. In an adjacent larger sepulchral chamber the upper levels were a mass of rubbish, possibly from the Assyrian occupation, but the lower levels were composed of a conglomerate of human skeletal remains, of which the condition suggests that they may have been thrown through a hole in the roof—the door on the west side was found still blocked—as salvage from the buildings, when the city was sacked by Sennacherib in 701 B.C.

This skeletal material will afford valuable evidence of the physical characters of the early inhabitants of Palestine, especially as a remnant of the Canaanitish population may have lingered on at Lachish. Even more interesting is the fact that, in addition to head wounds, several of the skulls show a number of pathological conditions. Some have been artificially deformed (Fig. 1) and show such elongation in the occipital region that they resemble in shape the form of head familiar in the representations of Akhenaton; others have been trephined. Of these latter, two examples, instead of the more usual circular operation, have had a square section of bone, about an inch across, removed by sawing cuts, which intersect. This method, known in the Inca skulls from South America, is new to the ancient civilization of the Old World.

# Educational Topics and Events

BELFAST.—Dr. W. H. McCrea, at present reader in mathematics in the University of London, has been appointed to the chair of mathematics in the Queen's University.

READING.—Under the will of the late Dr. Alfred Palmer, who died on May 20 last, the University has benefited by a valuable bequest of freehold property. It includes the main buildings of St. Andrew's Hall, the largest of the University's halls of residence for women students; a house known as "Summerbrook", near the main University site, which serves as the headquarters for the advisory officers of the Southern Agricultural Province; two houses used by Wessex Hall, another of the University's halls of residence for women students; four houses adjoining the main University site and used for general University purposes. The properties, which have hitherto been held on lease by the University, have been bequeathed free of duty.

Mr. Gerald E. H. Palmer has been elected a member of the University Council to fill the vacancy caused by the death of Dr. Alfred Palmer.

Mr. G. T. H. Kimble has been appointed lecturer in geography.

SHEFFIELD.—The following appointments have recently been made: Mr. N. S. Boulton, as lecturer in civil engineering; Mr. W. S. Milner (at present assistant lecturer), to be lecturer in electrical engineering; Mr. W. Skyrme Rees, as demonstrator in anatomy.

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"ACADEMIC FREEDOM" continues to form the subject of much anxious discussion in America. The president of the University of California in a recent speech on "Problems of an American University" (*School and Society*, May 30) declared that more and more in the last year or two his university has felt, in common with others, the pressure of special groups, and he drew a lamentable picture of what the loss of freedom has meant to the universities of Germany, Italy and Russia. In these countries, "to-day there are no universities—only names and shells from which the spirit has departed. In each of these totalitarian States, universities have become the agents, the adjuncts, the subordinates of the State". In the same journal in which this speech is reported appears a letter from the president of the University of Minnesota referring to the increasing amount of control the Federal Government is exercising over the schools of the country, and to the necessity of keeping the schools and universities free from dictation by pressure groups and from regimentation by Government agencies. In the preceding issue, Prof. Thomas Woody, of the University of Pennsylvania, writes of the "hysterical efforts to create loyal citizens by legislative fiat" in recent attempts to pass laws to keep history "pure", and to regulate and restrict the teaching of science. "Even more serious in its ultimate possibilities for the suppression of freedom of the schools and colleges of the nation is the present obsession with respect to loyalty oaths for teachers". He proceeds to examine at length the grounds on which the requirement of such oaths (now prescribed in nineteen States) has been defended.

## Science News a Century Ago

### Sir Goldsworthy Gurney and his Steam Carriages

AMONG the successful pioneers of steam locomotion on roads was Sir Goldsworthy Gurney (1793–1875), the Cornish surgeon and inventor, known also for his invention of the oxy-hydrogen blowpipe and the limelight. It was while living in London that he turned his attention to steam-carriages, and in 1829 he went from London to Bath and back at a rate of fifteen miles an hour. On July 18, 1836, in the House of Lords, reference was made to the Steam-carriages Tolls Bill which had then passed through the committee stage. The Marquess of Salisbury, however, proposed it should be referred to a select committee for further consideration. In the course of his reply to this suggestion, the Earl of Radnor said: "Mr. Gurney, a gentleman of considerable talent, had directed all his attention to the construction of steam-carriages applicable to the road. He had given up a lucrative business, and applied himself wholly to that point. He had brought his invention to a state of great perfection; when all at once, a bill was introduced, not directly affecting his invention, but by a side-wind, entirely obstructing it, and laying such a tax on steam carriages as would completely defeat his object. His invention had been used without any accident whatever occurring; and this bill was intended merely to take off that burden which indirectly would operate greatly to the prejudice of Mr. Gurney".

### Geology of the Island of Ascension

ON July 19, 1836, H.M.S. *Beagle* reached the island of Ascension, which Darwin compared to "a huge ship kept in first-rate order". Speaking of the geology of the island, he said: "The lava streams are covered with hummocks, and are rugged to a degree which, geologically speaking, is not of easy explanation. The intervening spaces are concealed with layers of pumice, ashes and volcanic tuff. . . . In several places I noticed volcanic bombs, that is, masses of lava which have been shot through the air whilst fluid, and have consequently assumed a spherical or pear-shape. Not only their external form, but, in several cases, their internal structure shows in a very curious manner that they have revolved in their aerial course". Describing more particularly one of these objects, he said: "The central part is coarsely cellular, the cells decreasing in size towards the exterior; where there is a shell-like case about the third of an inch in thickness, of compact stone, which again is overlaid by the outside crust of finely cellular lava. I think there can be little doubt, first, that the external crust cooled rapidly in the state in which we now see it; secondly, that the still fluid lava within, was packed by the centrifugal force, generated by the revolving of the bomb, against the external cooled crust, and so produced the solid shell of stone; and lastly, that the centrifugal force, by relieving the pressure in the more central parts of the bomb, allowed the heated vapours to expand their cells, thus forming the coarsely cellular mass of the centre".

### The Herbarizing Dinner of the Society of Apothecaries

ON July 20, 1836, "the annual herbarizing dinner of the Society of Apothecaries took place . . . preceded by a lecture given at their hall by John Lindley, Ph.D., Professor of Botany to the Society. The noble President of the Medico-Botanical Society (Earl Stanhope), the Vice Presidents of the Linnean and Horticultural Societies, the President of the Royal College of Surgeons (Sir Astley Cooper), the ex-censors of the Royal College of Physicians, the Professors of Botany at the Metropolitan Schools of Medicine, and about 150 other gentlemen, attended on the occasion" (*The Times*).

### Death of Jean-Félix-Adolphe Gambart

ON July 23, 1836, the French astronomer Jean-Félix-Adolphe Gambart, died at the early age of thirty-six years. He was born at Cette, in the Department of Hérault in May 1800. While quite a young boy he went to sea and then lived with his father, a teacher of navigation at Havre. His talents having attracted the attention of Alexis Bouvard (1767–1843), "the computing partner" of Laplace, he went to Paris, and in 1819 through Bouvard was made an assistant at the observatory at Marseilles of which Jean Louis Pons (1761–1831) was then the director. Pons having removed to Italy, Gambart in 1822 was made director of the Observatory, and though supplied with somewhat inferior instruments, in the course of eleven or twelve years discovered thirteen comets, including Biela's comet, first seen on February 17, 1836. In recognition of his work he was made a member of the Paris Academy of Sciences. Recalled to Paris in 1834 for work at the Bureau des Longitudes, his promising career was cut short by consumption.

### Medical Statistics

IN his retrospective address delivered at the third anniversary meeting on July 23, 1835, of the Provincial Medical and Surgical Association held at Oxford, Dr. J. C. Prichard, F.R.S., senior physician to the Bristol Infirmary, said that there could be no method of research more in harmony with the philosophical character of the present age than inquiries which were termed statistical. There was no investigation more calculated to extend our knowledge, on a great scale, both of the physical and moral condition of mankind without opening the door to anything discursive or imaginary. Statistical researches were likely to afford the most satisfactory solution of difficult problems which had hitherto been thought to lie within the realm of speculation; and our mistrust of the speculative way of treating such questions was increased by the remark that in almost every inquiry submitted to the test of accurate numerical calculations, the result had turned out in direct opposition to what appeared to be the most probable conjecture. Who, for example, would ever have imagined that human life would not exhibit a larger average duration in the genial climate of Greece, Italy and other countries on the northern coast of the Mediterranean . . . than on the inclement shores of the Baltic and Frozen Ocean? It had been demonstrated, however, in a memoir drawn up with great accuracy of research and presented to the Academy of Sciences that human life had double the duration, or that men lived on the average twice as many years in the *Ultima Thule*—the bleak Iceland and on the Norwegian coast—as in the delightful plains of Campania and in the valleys of Andalusia.—(*Trans. Prov. Med. and Surg. Assoc.*, 1836.)

# Societies and Academies

## Paris

Academy of Sciences, June 8 (*C.R.*, **202**, 1881–1952).

ANDRÉ BLONDEL: A radioelectric method for the calculation of transient régimes.

GEORGES CLAUDE: The presence of gold in sea-water. An application of the method suggested by Glazunov to 168 cubic metres of sea-water taken off the coast of California. The gold was too small to be determined, and was less than 0·1 mgm. per cubic metre.

DIMITRI RIABOUCHINSKY: The paradox of d'Alembert at supersonic velocities.

EDGAR BATICLE: The problem of collisions.

SALVATORE CHERUBINO: Holomorph functions of a matrix.

LÉON POMEY: The general harmonic properties of unicursal involutions of order $n$.

RENÉ LAGRANGE: An inequality of Hobson.

ALEXANDRE WEINSTEIN: The equations of the vibrations of a fixed-in plate.

MLLE. NINA BARY: The Diophantic nature of the unicity problem of the trigonometrical development.

JEAN HELY: The application of a synthetic theory of relativity to the orbits of the planets.

CHARLES PLATRIER: The problem of Barré de Saint-Venant in perfectly flexible homogeneous media.

IMAI-ISAO: The stability of the double row of vortices in a rectilinear canal.

A. TOUSSAINT and S. PIVKO: The influence of the limitations of the fluid sheet on the aerodynamic characteristics of supporting wings. Experimental verifications.

BERNARD KWAL: Dirac's equation and the theory of the electromagnetic field.

MARCEL PAUTHENIER and MME. MARGUERITE MOREAU-HANOT: An ionic generator giving a million volts. Details of the practical realization of an apparatus based on a theory previously described.

JEAN GRANIER: An important cause of error in the measurement of capacities by the ballistic method. In measuring condensers of high capacity, either the variations of period must be taken into account or less sensitive galvanometers, heavily shunted and with a high moment of inertia, must be used.

JEAN LECOMTE: Infra-red absorption spectra and the modes of vibration of organic compounds. From the study of compounds of the types $X.CH_2CH_2.Y$ and $X.CH_2.CH_2.CH_2.Y$, the numerous absorption bands found in nearly all the spectra for frequencies lower than 1,100 cm.$^{-1}$, can be explained only if the existence of several molecular forms is admitted.

JEAN REBOUL: The action exerted by ordinary metals on the photographic plate and on the electrometer. The study of the ionization of the atmosphere surrounding ordinary metals, suggests that there is an emission by these metals of an X-radiation of small quantum. The action on the photographic plate is not parallel to the ionization, and Russell's suggestion of the formation of hydrogen peroxide may apply in some cases.

PIERRE AUGER and ALBERT ROSENBERG: The properties of the cosmic corpuscles of the penetrating group.

HORMISDAS: A new colorimeter for determinations in series.

HORIA HULUBEI: Researches relating to element No. 87. The results of experiments given are consistent with the presence of element 87 in extremely small quantity in pollucite.

CLÉMENT COURTY: The diamagnetism of thiocyanates and of the ion $Cu^+$.

MARC TIFFENEAU and MLLE. B. TCHOUBAR: The differences of behaviour of the *cis* and *trans* cyclohexanediols during their dehydration.

ALBERT KIRRMANN and PIERRE RENN: The mechanism of the allyl transposition.

FRANÇOIS DUPRÉ LA TOUR: Inversion of polymorphism in the series of normal saturated diacids.

GEORGES REMPP: A differential frigorimeter. A simple instrument for measuring the mean velocity of the air, possessing a greater thermal inertia than the hot wire anemometer.

ETIENNE FŒX and MAURICE LANSADE: The pathogenic action of a bacterium isolated from potato tubers. The characters of this organism agree with those of *Bacterium xanthochlorum*. Studies have been made of its pathogenic action on potato tubers and buds, leaves of Solanaceæ and Leguminoseæ and on seeds of Solanaceæ.

PAUL RIOU and JOACHIM DELORME: The lead values in maple and cane sugars. From a determination of the lead values of cane sugars from various sources, it is concluded that this value can give no indication of the adulteration of maple sugar with raw cane sugar.

ALBERT RAYNAUD: The heterochromosomes of mulot.

ROBERT BRUNET and ANTOINE JULLIEN: The architectural characteristics of the heart in two marine lamellibranchs, *Ostrea edulis* and *Venus gallina*.

MLLE. MARIE LOUISE ROCCO: The presence of allantoinase in insects. The aerial arthropods, like the aquatic arthropods, contain the enzyme allantoinase.

FRANCIS RATHERY, ANDRÉ CHOAY and PIERRE DE TRAVERSE: Isolation from the mucous membrane of the jejunum of a principle reducing glycæmia.

MAURICE DOLADILHE and MLLE. MARGUERITE MICHEL: Contribution to the study of the alexic properties of protein C.

# Official Publications Received

## Great Britain and Ireland

Fifty Years a Borough, 1886–1936: The Story of West Ham. Edited and compiled by Donald McDougall. Pp. 298. (West Ham: Central Library.) 3*s*. 6*d*. [296

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1936. Pp. xii+72. (Aberdeen: North of Scotland College of Agriculture.) [37

## Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 97: Studies on Contagious Pleuro-Pneumonia of Cattle. By A. D. Campbell, Dr. A. W. Turner, Dr. H. R. Seddon and Dr. H. E. Albiston. Pp. 88. Bulletin No. 98: Cercospora Leaf-Spot (Frogeye) of Tobacco in Queensland. By A. V. Hill. Pp. 46+7 plates. Pamphlet No. 62: The Chemistry of Australian Timbers. Part 5: A Study of the Lignin Determination, 3. By Dr. W. E. Cohen. (Division of Forest Products: Technical Paper No. 20.) Pp. 30. Pamphlet No. 63: Studies of Five Introduced Grasses. By Dr. A. McTaggart, W. Hartley, T. B. Paltridge and H. K. C. Mair. Pp. 32+2 plates. (Melbourne: Government Printer.) [226

Peabody Museum of Natural History. Bulletin 4: Miocene Marine Mammals from the Bakersfield Region, California. By Leslie E. Wilson. Pp. 143. (New Haven, Conn.: Yale University.) 1.25 dollars. [246

Proceedings of the United States National Museum. Vol. 83, No. 2986: A New Genus and Species of Trematode from the Little Brown Bat and a Key to the Genera of Pleurogenetinæ. By Ralph W. Macy. Pp. 321–324. (Washington, D.C.: Government Printing Office.) [246

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# The Planning of Human Life

THERE must be many among the ranks of scientific workers who, from time to time, have been alarmed at the consequences which might attend the further extensions of the restrictions on freedom of scientific thought and investigation already imposed in various European countries and elsewhere, or the continued prostitution of scientific effort on an ever-growing scale on preparations for war. Others have been disturbed at the paradox presented by the heavy incidence of unemployment and distress in a world which science has already endowed with resources undreamed of scarcely a generation ago.

Few, however, as yet have concerned themselves with the underlying causes of the present unhappy and threatening position, and Prof. L. T. Hogben's recently delivered Conway Memorial Lecture* is accordingly the more welcome because of its stimulating challenge to creative thought on new lines about social life, and therefore about politics and economics. His outspoken comments were much more than a plea for a biological basis for social and political thought. The whole lecture was a call for a courageous linking of knowledge and action and seeing life as a whole, in which scientific method finds its use in arriving at new knowledge and solving practical problems, and action is seen as an essential if life is to be achieved in its fullness.

At a time when what Prof. Hogben describes as the retreat from reason is at full flood, it is refreshing and inspiring to meet such a frank exposure of past failures and an exposition of new lines of advance which may yet retrieve the position. Science could desire no better apologist, and even those who are unconvinced by Prof. Hogben's arguments can scarcely fail to admit the impossibility of tame acquiescence in the present position, unless we are content to see the very spirit of science slowly choked to death.

The retreat from reason, the growing dominance of prejudice and ignorance in public affairs, is attributed to neglect of education. The most expensive products of the educational system of Western civilization are really uneducated for life in the present world; and democracy is becoming a farce, because this expensively educated class, from which Capital and Labour attract the leaders and administrators, is increasingly at the mercy of technical experts whose own training involves no recognition of their social responsibilities.

The training of the statesman or the man of letters gives him no prevision of the technical forces which are shaping the society in which he lives: the education of the scientific worker and the technician may well leave him indifferent to the social consequences of his own activities. If we are to arrest the retreat from reason, we must devise an education which will give us representatives who can co-operate intelligently with technical experts in constructive social enterprise, and teach us how to choose them.

This is the first task, and upon it Prof. Hogben makes many shrewd remarks. He questions, for example, whether we now have as large a proportion of scientific men actively interested in politics as there were at the time of Joseph Priestley and Benjamin Franklin. Moreover, a nation cannot expect men of science to help in times of difficulty unless it elects representatives who know enough about the scope of technical possibilities to enlist their skill. If, however, a man is not

* The Retreat from Reason. By Lancelot Hogben. (Conway Memorial Lecture delivered at Conway Hall, Red Lion Square, W.C.1, on May 20, 1936.) Pp. xi+88. (London: Watts and Co., 1936.) Paper, 1s. net; cloth, 2s. net.

politically educated unless he has some knowledge of natural science, the teaching of natural science has still to be adapted to the requirements of a rational curriculum of humanistic studies. We need more science, but not more science as it is taught for vocational purposes.

The real reason why science must be an important part of education is that intelligent citizenship is no longer possible unless we understand the place of science in the everyday life of everybody. Attention is directed to the closer co-operation between the teaching of history and of natural science in school and university alike which this demands. Co-operation between the historian and the man of science is, in fact, required to make education socially fertile; and the social value and interest of scientific teaching could be further enhanced if the relation of growing knowledge to the developing social needs of mankind were emphasized in the teaching of natural science.

The interest which the British Association has taken in the relation of scientific work to social questions in recent years indicates that Prof. Hogben is not alone in many of his arguments. To reinstate confidence in human reason, however, the teaching of history in such a way as to produce citizens capable of realizing the part which advancing scientific knowledge has played in the material progress of mankind is only one factor. The teacher of science can and should let his pupils understand from the beginning what are the responsibilities in everyday life which scientific discipline lays on all those who have once submitted to it, but that in itself it is not sufficient to secure action in discharge of those responsibilities.

No single point is so strongly stressed by Prof. Hogben as this of action. Quoting T. H. Huxley that "the great end of life is not knowledge but action", he suggests that the divorce of thought from action is one of the prime causes of our present difficulties. The pursuit of the social sciences has not been closely linked with the development of new institutions and the discovery of new modes of social living; and unless knowledge is encouraged as a means to action instead of as a means to more knowledge, we are unlikely to regain control over events and reap the possibilities of plenty which science has put within our reach.

Lack of familiarity with scientific matters has been an important factor in the crumbling away of our social traditions under the stress of economic disaster, but we can only stabilize the new social pattern by securing that action is related to knowledge and that the new knowledge to be acquired is pursued in relation to a definite plan of action. We have still to discover the laws of change of human nature, and until in this way we have arrived at a science of human nature, it is idle to expect the public needs of a progressive society to harmonize with the private needs of human nature.

Nor is this all. We are blundering on the threshold of an era of technical changes, the consequences of which can scarcely yet be predicted even by the technical man, let alone visualized by the average administrator. The introduction of the new plastics in building, housing and clothing, the replacement of heavy metals by light metal alloys in constructional work, changes in power production, increased productivity of pastures, field crops and live-stock through the use of fertilizers, soil control, genetic selection and control of pests, hold revolutionary consequences which demand study and reconstruction in all directions.

Equally we are entering on an era of biological inventions, with new possibilities of bodily and mental health if our resources are planned intelligently with the object of satisfying real human needs. A rational basis for human society involves planned consumption to ensure the maintenance of population. The only rational basis for such planning is scientific research into the character of fundamental human requirements and the national resources available for gratifying them. We could then formulate a policy and programme of national reconstruction which would command the irresistible support of the wage-earning and salaried classes, and should be above the squabbles of party politics as we have known them. When the existence of a universal need is recognized, the problem of satisfying it is a joint matter for economists and technicians.

A science of preventive social medicine must have as its first concern the satisfaction of known universal needs, and psychologists should be encouraged to explore the distribution of human capabilities in relation to the idiosyncratic requirements of individual human beings. Prof. Hogben, in fact, boldly calls for an inquiry into the wealth of nations on entirely new lines, including the utilization of social personnel and the study of the social resources available for canalizing a common will to increase the wealth of nations. In regard to the first, the studies of recruitment he suggests, including the large-scale testing of Parliamentary candidates for vocational

aptitudes on similar lines to those worked out for various purposes by the National Institute of Industrial Psychology, though likely to meet with ridicule at the moment, would represent a real contribution to political science and society.

The picture which is thus presented to us does not minimize the dangers of the present situation ; rather it reminds us once more that the way of escape is still open if we choose to take it. The planning of human life, in accordance with growing knowledge of the nature of fundamental human needs and the natural forces now at our disposal if we use them intelligently, is not a task which can be or will be undertaken by political leaders, who have little regard for the nature of human needs and are unfamiliar with the technical resources which can be mobilized by intelligent organization.

The scientific worker, therefore, cannot evade his share of responsibility. He, at least, must lend his aid if anyone is to take stock of the resources of knowledge for social betterment. He as no other can lead the return to the exposition of the simple and well-tried truths of science, and resist the exploitation of speculative, socially insignificant and unproved hypotheses before mystified audiences. Also he can lend his support both to the re-orientation of scientific research in accordance with a real plan of social research, and to the political and social forces necessary to compel action along the lines of knowledge rather than those of prejudice.

# Enzyme Studies

**Ergebnisse der Enzymforschung**
Herausgegeben von F. F. Nord und R. Weidenhagen. Band 5. Pp. xi + 378. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1936.) 30 gold marks.

THESE "Ergebnisse" once more contain valuable summaries of selected sections in the continually expanding field of biochemistry included under the term 'enzymes'. The contributions are as international as ever, but only the minority are from German laboratories : it is an interesting question whether this denotes a falling off in scientific activity there under present political conditions.

Prof. Alex. McKenzie of Dundee gives the complete story of asymmetric synthesis, a subject to which he has devoted his energies and which has not been monographed as yet. Very opportune is an account written by Folley and Kay, fifty-four pages in length, of the phosphatases, since the substrates on which they act, the phosphoric esters, hold a key position in many of the processes taking place in living organisms : thus they are concerned in alcoholic fermentation, muscular contraction, bone formation and lactation, whilst the many phospho-organic compounds in living matter are probably all dependent on the activity of phosphatases. At present there is no real understanding of the true role of these enzymes, but much progress can be reported in the accumulation of facts : the summary should help to arouse fresh interest in the subject. It is followed by an article on lecithase, the mixture of enzymes which hydrolyse lecithin in a variety of ways : this is from Milan and is written by Messrs. Belfanti, Contardi and Ercoli. No less than seven different enzymes take part in the simplification of lecithin by a series of steps which thus afford a very interesting biological problem.

Another summary, dealing with a problem which is still unsolved despite its importance, is that on the biochemical synthesis of fats, from the pen of Dr. Smedley Maclean. We know that the pig in particular is able to effect the transformation with ease, but neither the site in the body where it happens, nor the nature of the first products of the synthesis, has been determined. The author inclines to the theory, for which there is some experimental support, that pyruvic acid is the intermediate stage, rather than accepting the alternative formation of fat direct from hexose or through acetaldehyde.

There is a stimulating article on proteases by Grassmann and Schneider, of Dresden. Since Northrop has been so successful in obtaining some of these enzymes in the crystalline state, enhanced interest is attached to their behaviour. It is now possible to lay down exact conditions for the structure of the substrate favourable for the action of the peptidases, and the same applies to the carboxy-polypeptidases, which require also a free carboxyl group in the substrate. Progress is also to be recorded in the identification of some of the active groups in these substances.

A group of enzymes, of which the knowledge is vague, are those that hydrolyze the pectins : a useful summary about them is provided by Kertesz, of Geneva, N.Y. Pectinase appears to be

a complex of enzymes containing at least a polygalacturonase and a pectin methoxylase, the former being a glycosidase and the latter an esterase: other constituents appear to be able to split off arabinose or galactose from the pectin complex. This is obviously a field requiring much further investigation.

Müller, of Copenhagen, describes an oxidase prepared from *Aspergillus* or *Penicillium*, which is able to oxidize glucose to gluconic acid with atmospheric oxygen: the significance of this reaction in the economy of these fungi is discussed.

Space considerations allow only of reference to one other review, namely, that on chlorophyll photosynthesis, from the pen of Robert Emerson of Pasadena. The review is opportune, for the subject continues to be a very difficult one, and in spite of a lot of work there has been no great progress in it during the last decade. At least the behaviour of enzymes towards carbon dioxide is being studied energetically, whilst a great deal more is known about chlorophyll.

The items which have been picked out for comment serve to indicate the value of the book: the editors once more deserve thanks for providing such stimulating fare. E. F. A.

# History of Medicine

## (1) The Story of Medicine in the Middle Ages

By Prof. David Riesman. Pp. xii+402. (New York: Paul B. Hoeber, Inc., 1935.) 5 dollars.

## (2) A Short History of Talmudic Medicine

By Dr. J. Snowman. Pp. 94. (London: John Bale, Sons and Danielsson, Ltd., 1935.) 3*s*. 6*d*. net.

## (3) Medical Practitioners in the Diocese of London

Licensed under the Act of 3 Henry VIII, C. II.; an Annotated List 1529–1725. By J. Harvey Bloom and R. Rutson James. Pp. viii+98. (Cambridge: At the University Press, 1935.) 5*s*. net.

## (4) An Essay on the External Use of Water

By Tobias Smollett. Edited, with Introduction and Notes, by Claude E. Jones. (Reprinted from *Bulletin of the Institute of the History of Medicine*, Vol. 3, No. 1, January 1935.) Pp. 31–82+1 plate. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1935.) 4*s*. 6*d*. net.

## (5) The Story of the Middlesex Hospital Medical School

Written at the request of the Council of the Medical School on the Occasion of the Centenary. By Dr. H. Campbell Thomson. Pp. xiii+182+20 plates. (London: John Murray, 1935.) 10*s*. 6*d*. net.

## (6) American Medicine

By Dr. Henry E. Sigerist. Translated by Hildegard Nagel. Pp. 316+30 plates. (New York: W. W. Norton and Co., Inc.; London: Oxford University Press, 1934.) 16*s*. net.

(1) THE work on medicine in the Middle Ages by Dr. David Riesman, professor of the history of medicine in the University of Pennsylvania, contains an admirably comprehensive study of the medical aspects of an age which until recently had received comparatively little attention. As Dr. Riesman points out, we are in the first place indebted to medieval medicine for the preservation of the writings of the Greeks, Romans, Arabians and Jews, without which progress in medicine would never have taken place. As regards Arabian medicine, he judiciously remarks that it is yet too early to pass a final judgment in view of the probable existence of many undeciphered texts, but he brings forward in its favour the preservation of many texts, many chemical discoveries, good advice concerning diet, a clear account of many diseases, and a considerable number of plant remedies.

The work of the universities, the foundation of which Dr. Riesman regards as probably the greatest achievement of the Middle Ages, next receives attention, special chapters being devoted to the medical personalities and studies at Montpellier, Bologna, Padua, Paris and Oxford and Cambridge respectively.

Considerable attention, of course, is given to the description of the various diseases prevalent in the Middle Ages, of which the most important were plague, leprosy, sweating sickness, St. Anthony's fire, the King's Evil and epilepsy. The vexed question as to the existence of syphilis in medieval times is fully discussed, the author being of opinion that it is not yet possible to say definitely whether the disease was imported from America or not. Other aspects of medieval medicine considered are alchemy, the hospitals of the period, medicine and the guilds, medical text-books in use, hygiene and sanitation, and the lay attitude towards the medical profession with special reference to the unkindly criticisms of Petrarch and Chaucer.

In conclusion, Dr. Riesman points out that the greatest difference between modern times and the Middle Ages in medicine, as in all sciences, is the objective experimental method characteristic of modern times. The text is liberally interspersed with portraits and other illustrations.

(2) In his little book on Talmudic medicine, which is based on the works of Julius Preuss, I. L. Katzenelsohn and M. Pearman, Dr. J. Snowman describes the medical conceptions current among the Jews during the Talmudic period, that is, from A.D. 200 to 600. An excellent account is given of the Talmudic theories as to the causation and cure of diseases, contemporary anatomy and physiology, and the progress made in the various branches of medicine.

The descriptions of superficial anatomy in the Talmud are remarkably accurate, but owing to the absence of dissection little could be learnt about the internal organs, though fanciful views were expressed as to their functions. The medical diseases mentioned in the Talmud include acute intestinal disorders probably due to dysentery, and leprosy, quinsy, cold in the head, worms and headaches, while the surgical disorders consist of superficial wounds, stone in the bladder, abscesses, burns and scalds, bites of mad dogs, snake-bites and fractures and dislocations. A special chapter is devoted to the minor operations of ritual circumcision and venesection, which was used for therapeutic and hygienic purposes.

As regards gynæcology and obstetrics, the diseases of women mentioned in the Talmud are mainly connected with uterine hæmorrhage. Difficult labour is frequently noted; sacrifice of the infant and Cæsarean section appear to have been practised. Diseases of the eye are frequently mentioned, especially cataract and corneal opacities.

The rabbis' knowledge of comparative anatomy, though gained only from the study of certain cattle, sheep and poultry, seems to have been remarkably extensive, being concerned with changes in the lungs, brain, heart, liver, spine, stomach, gall-bladder and intestines.

(3) In their work on medical practitioners in the diocese of London 1529–1725, Messrs. J. Harvey Bloom and R. Rutson James have compiled an annotated list drawn from various sources of those licensed to practise under the Act of 3 Henry VIII, c. II in the diocese of London. The book does not contain the names of all the practitioners in the diocese, as those licensed by the Royal College of Physicians as well as some surgeons and barber surgeons are not included. The Act laid down that no person within the City of London or within seven miles of the same should take upon himself to practise as a physician or surgeon unless he had been first examined, approved and admitted by the Bishop of London or by the Dean of St. Paul's, assisted by doctors of physic and other expert persons in the faculty of surgery. Of the examiners, the only well-known names that have been preserved are those of Sir Hans Sloane, president of the Royal Society and of the Royal College of Physicians, John Evelyn the diarist, and the infamous Titus Oates.

The list contains in all 360 names, of which 184 have their documents preserved at Somerset House and 176 in the registry of the Bishop of London. The most eminent licencees in the list are William Clowes (1540–1604), the famous Elizabethan surgeon attached to St. Bartholomew's Hospital; Charles Bernard (1656–1710), Sergeant-Surgeon to Queen Anne, surgeon to St. Bartholomew's Hospital and owner of a fine library; Ambrose Dickins (1687–1747), surgeon to Westminster and St. George's Hospitals and Master of the Barber Surgeons' Company; and William Cheselden (1688–1752), surgeon to St. Thomas's and St. George's Hospitals and famous for his operations for stone and cataract. The Act was never repealed, but died a natural death through lack of applicants.

(4) Smollett's essay on the external use of water, which was originally published in 1752, is preceded by an introduction by Mr. Claude E. Jones, who remarks that Smollett's writings are of interest to the student of medical history for two reasons; first on account of his small ventures in the field of medicine proper, of which the present essay is an example, and secondly for the vast number of medical pictures and comments scattered through his other works.

The present essay purports to be a letter addressed to Dr** "on the external use of water with particular remarks upon the present method of using the mineral waters at Bath in Somersetshire, and a plan for rendering them more safe, agreeable and efficacious". After a brief account of the value of the internal use of pure water, Smollett describes its employment in the form of foot-baths, universal baths and fomentations in the treatment of various disorders. In conclusion, he directs attention to certain inconveniences attending the use of the waters at Bath, such as promiscuous admission of diseased persons of all ages, sexes and conditions into an open bath, the confinement of their use to the most severe seasons of the year, and the lack of attendants and proper conveyances, and draws up a series of proposals to remedy these inconveniences.

(5) The history of the Middlesex Hospital Medical School is admirably told by Dr. H. Campbell Thomson, consulting physician to the Department for Nervous Diseases at the Hospital, and from 1908 until 1919 dean of the Medical School. Although the school was not founded until 1835, teaching in the hospital began shortly after the hospital was established in 1745. The inaugural address on October 1, 1835, when the medical school was formally opened, was delivered by Sir Charles Bell, the eminent anatomist and artist, and one of the three surgeons to the hospital. It

is noteworthy that five of his colleagues on the staff were, like himself, fellows of the Royal Society, the most eminent of them being Sir Thomas Watson, the senior physician and professor of medicine in the School, whose work on the principles and practice of physic is a medical classic.

Since that time, the Medical School has had a number of famous men on the staff, the most remarkable co-existence of celebrities at one time being the triumvirate in 1906 consisting of Sir Henry Morris, president of the Royal College of Surgeons, Sir Richard Douglas Powell, president of the Royal College of Physicians, and Sir James Kingston Fowler, dean of the Faculty of Medicine of the University of London.

Two scientific institutes connected with the School deserve special mention, namely, the Bland-Sutton Institute of Pathology opened in 1914, and the Courtauld Institute of Biochemistry opened in 1928, where there are always a number of research workers from Europe and the United States.

(6) In the excellent English translation by Miss Hildegard Nagel of his work on American medicine, Dr. Henry E. Sigerist, professor of the history of medicine at Johns Hopkins University, who had formerly held the corresponding chair at Leipzig, has given a lively account of the development of American medicine, from the earliest times until the present day as seen by an unprejudiced and sympathetic observer.

The book contains an interesting account of primitive medicine in North America, followed by a description of medicine in the colonial period, biographical sketches of medical pioneers in the United States from John Morgan and Benjamin Rush in the eighteenth century down to Billings and Osler in our own time, the present condition of medical education with special reference to Johns Hopkins University, where attention is focused on science and research, the organization of hospitals and nursing, public health work including campaigns against infectious diseases, maternity and child welfare, mental hygiene and various scientific institutions connected with medical clinics.

Dr. Sigerist rightly claims that whereas fifty years ago American schools counted for nothing in world medicine, to-day the standard of education equals that of most European countries and in many places and in some points is superior.

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# Theory and Practice of Electrochemistry

**(1) Electrolytic Oxidation and Reduction:** Inorganic and Organic. By Dr. S. Glasstone and Dr. A. Hickling. (Monographs on Applied Chemistry, Vol. 9.) Pp. ix+420. (London: Chapman and Hall, Ltd., 1935.) 25*s*. net.

**(2) Principles of Experimental and Theoretical Electrochemistry**
By Prof. Malcolm Dole. (International Chemical Series.) Pp. xiii+549. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30*s*. net.

**(3) Principles and Applications of Electrochemistry**
By Prof. H. Jermain Creighton. In 2 vols. Vol. 1: Principles. Third Edition, revised and enlarged. Pp. xviii+502. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20*s*. net.

**(4) Principles and Applications of Electrochemistry**
By Prof. W. A. Koehler. In 2 vols. Vol. 2: Applications. Pp. xiv+545. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 25*s*. net.

SOME sections of the broad science of chemistry are purely theoretical, others are essentially practical, but electrochemistry in its modern developments combines the two aspects. The appreciation of its principles demands an intensive knowledge of mathematics and thermodynamics; the application of those principles to industrial purposes is of fundamental importance, both on the inorganic and on the organic sides. No Chancellor of the Exchequer needs to ask to-day, as Gladstone did: "What's the use of it?"; he has long ago taken advantage of Faraday's reply to the question: "Why, sir, there is every probability that you will soon be able to tax it!"

(1) The monograph by Drs. Glasstone and Hickling illustrates to an unusual degree the close intermingling of present-day electrochemical theory and practice. As the preface states, purely empirical methods are no longer satisfactory in the control of industrial processes, and success in such operations can only follow from an understanding of the fundamental principles involved.

The basic theory of the subject is clearly presented in this book, and a multitude of practical illustrations discussed in detail. Full references to scientific and patent literature are appended at the end of each chapter, and the hope of the authors that "the book will be of value both to research workers and to technical chemists interested in the enormous possibilities of

electrolytic methods" will no doubt be amply fulfilled. The book is one to be highly recommended.

(2) The volume by Prof. Dole, of Northwestern University, Illinois, is more restricted in its scope, dealing as it does only with the theoretical principles of electrochemistry. These principles, however, are introduced throughout from an experimental angle, so that in spite of the fact that the main stress of the book is upon the interpretation of electrochemical phenomena, the student who has conscientiously studied each chapter should be well equipped to put the knowledge acquired to practical use if necessary. The book constitutes a serviceable text for honours students specializing in electrochemistry and for Ph.D. research workers in this branch of the subject.

(3) The fact that Prof. Creighton's "Principles of Electrochemistry" has now reached the stage of a third edition is evidence of its popularity and merit. The treatment is elementary but thorough, and furnishes a most readable introduction for the student of electrochemical theory. In order to bring certain topics into harmony with recent advances, a great many portions of the second edition have been rewritten and new subject matter has been added. The problems inserted at the end of nearly every chapter and the numerous references to original papers add materially to the value of the book.

(4) "Applications of Electrochemistry", by Prof. Koehler, forms a companion volume to Creighton's "Principles". It is intended for two classes of readers: students in universities, colleges and technical schools for use as a textbook; and persons connected with the industry for use as a reference work. The difficult problem of making the book sufficiently complete and up-to-date without at the same time making it too voluminous for academic purposes has been very successfully met, and the impressive list of experts to whom the author makes acknowledgment for assistance and suggestions bears witness to his assiduity in ensuring accuracy in each section of the field covered.

Practically every point of importance in inorganic electrochemical industry is presented in a clear and compact manner, and the presentation is assisted materially by a large number of plates, diagrams and tables. Organic electrochemistry, presumably for reasons of space, is scarcely touched. A third volume of the series, treating this subject in the same admirable style, would be warmly welcomed. JAMES KENDALL.

# Forests and Flora of British Honduras

**The Forests and Flora of British Honduras**
By Paul C. Standley and Prof. Samuel J. Record, in cooperation with the Conservator of Forests and the Agricultural Officer of the Colony. (Botanical Series, Vol. 12, Publication 350.) Pp. 432+16 plates. (Chicago: Field Museum of Natural History, 1936.)

FOLLOWING a short introduction on the geography, soils, climate, agriculture and forest products of British Honduras, the remainder of this substantial volume is divided into two parts, entitled respectively "The Forests" and "The Flora". In Part 1, which occupies about thirty pages, and is contributed by Prof. Record, a description is given of the forests, with a short history of the same, and a reference to and description of most of the timbers of economic importance, including uses as timber and also for pulp, with an interesting account of the Chicle gum industry. Throughout the remainder of the work Prof. Record has also contributed a description of the different woods wherever they are named, and he states that "the wood descriptions are short because all of the more important species have been covered more fully in 'Timbers of Tropical America' or in special articles in *Tropical Woods*".

Part 2, comprising the whole catalogue of the trees and shrubs of British Honduras, is the work of Mr. Standley, no doubt greatly assisted by the knowledge acquired by Prof. Record, who "began about ten years ago to compile a list of all of the available scientific and local names of the woody plants of the Colony". This splendid production is of first importance as presenting an authoritative work on a much needed subject, and comes at a timely moment, because—perhaps for the first time—a vigorous reorganization of the Colony's timber production and conservation is at work.

Prof. Record points out that "although British Honduras has been a timber-producing country for 250 years, systematic forestry was started only in 1922 with the formation of the Forest Department". This Department is vested in a Forest Trust with the Governor as chairman, and the policy laid down includes an excellent programme which should very soon yield many results, not the least of which is to find a market for some of the useful secondary woods. The work provides a full list,

enabling the timber expert to trace the vernacular names to the correct identification of the botanical types, and provides the same advantages to the large number of people who are enthusiastic collectors of useful and ornamental flowering shrubs.

A painstaking and conscientiously accurate description is given of the measurement of the trees, leaves, flowers and fruit, together with the districts in which they abound.

The history of this tropical country is full of romance and interest. Why the Maya peoples settled there, or whence they came seems to be undecided. In the beginning, their fight against Nature and the jungle must have been very severe, but at last they succeeded and established their cities. Then again Nature reasserted herself, and in course of time turned them out.

Gann and Thompson say:

"those cities which were ill situated, from an agricultural point of view, would naturally be the first deserted, while the cities in the fertile lands of north-eastern Peten would be amongst the last.

"Whatever the cause, it is certain that by the third Katun of Bactun 10, or 629 A.D., the whole of the Old Empire was almost completely abandoned, and remained so for the next seven or eight centuries, when reforestation of the lands enabled at least a part of the descendants of the original dwellers to return to the home of their ancestors."

The same authors inform us that it took 250 years for the Maya to evacuate the land. They state that the reason for the evacuation is not known, but they mention seven possible reasons, of which the sixth is "exhaustion of the soil". The other reasons are: "1. National decadence. 2. Epidemic disease. 3. Earthquakes. 4. War, internecine or foreign, or both combined. 5. Climatic changes. 7. Religious or superstitious reasons."

The practice followed by almost all primitive peoples was to cut down the trees and shrubs over one area, and move on after a year or two, repeating the same process in another, which must at last have rendered the whole country barren of trees, so that erosion of the soil would have followed in the same way as in other countries. There seems to be little doubt, therefore, that the sixth reason referred to above, namely, "exhaustion of the soil", was the cause of the final evacuation.

The romance of this country did not finish with the departure of the Maya. The story of the early British voyagers who visited these far distant countries is fairly well known. Prof. Record informs us that:

"It was at one time the practice of the class of privateers . . . cruising against Spanish traders to set fire to all vessels they captured which might be laden with Logwood, having first stripped them of everything valuable.

"But it so happened that a Captain James, the master of a letter of marque, having captured a Spanish vessel the cargo of which consisted of this wood, brought the ship and cargo into the Port of London. On endeavouring to dispose of the latter he was gratified as well as surprised to find for it a ready sale at an enormous price per ton. The crew, who had used up a portion of the precious freight to burn in the galley fire, had little idea that they were using fuel at a hundred pounds per ton during the voyage."

No less romance is attached to the beginning of the trade in mahogany, which is supposed to have begun about 1725. A little later, in 1786, a treaty was made between Great Britain and Spain, which gave the right to British settlers to cut wood "not excepting even mahogany".

Having regard to the importance and value of this colony, it seems incredible that a recognized forestry service should have been started only in 1922, but with the competent activities of the present Governor, and the Conservator of Forests, good results may confidently be expected. There can be no stronger indication of its importance than the interest shown by the two very well-known authors of the present work—Samuel J. Record and Paul C. Standley. Prof. Record had already provided generous contributions to our knowledge of forests and their products, and this new book comes at a most opportune moment.

ALEXANDER L. HOWARD

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**Das Tierreich:**
eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Gegründet von der Deutschen Zoologischen Gesellschaft. Im Auftrage der Preussischen Akademie der Wissenschaften zu Berlin. Lief. 65: Lepidoptera—Parnassiidæ pars 2 (subfam. Parnassiinæ). Bearbeitet von Felix Bryk. Pp. li + 790. (Berlin und Leipzig: Walter de Gruyter und Co., 1935.) n.p.

THE contents of this extensive work are embodied in the title. It monographs the genera and species of 'Apollo' butterflies forming the subfamily Parnassiinæ together with their numerous forms of subspecies. In each case, the synonymy is given, followed by a description of the species and form concerned, its distribution and the location of the type specimens. It is profusely illustrated by means of 698 text-figures of the various species, together with structural details of a diagnostic character. The extraordinary range of forms into which the various species are divisible has made the genus a specialized study among lepidopterists. In the case of *P. apollo*, for example, the index alone of the forms of this species runs to five pages of double columns. A detailed and authoritative work of this kind is likely to remain a standard for a number of years.

**The Subject Index to Periodicals, 1935**
Pp. xiii + 235. (London: The Library Association, 1936.) 70s.

WITH this issue the "Subject Index to Periodicals" completes twenty years of existence, the first volume published being for the year 1915. The volume for 1935 appeared only five months after the close of the year covered. The general editor, Mr. T. Rowland Powel, his staff and the voluntary contributors are to be congratulated on the rapidity with which the work has been carried out. The Subject Index for 1935 comprises entries of about 26,000 articles selected from 590 periodicals. Of these periodicals 540 are English and American, 27 French and Belgian, 21 German, and 2 Italian. The articles selected are arranged under headings such as "Light", "Lighting", "Lightning", etc., but under each heading the order is that of authors' names.

The subjects selected for indexing are by no means confined to science, but cover a wide range. Verse and fiction are excluded. With few exceptions, no attempt has been made to index periodicals already indexed in the following: *Agricultural Index*, *Engineering Index*, *Engineering Abstracts*, *Index Medicus*, *Journal of the Society of Dyers and Colorists*, *Photographic Abstracts*, *Revue de Géologie*, *Royal Meteorological Society Bibliography*, *Science Abstracts*, *Textile Institute Journal*.

All workers in science value these Subject Indexes, and appreciate the care and efficiency which, under the auspices of the Library Association, have been devoted to their production. It is probable that many a valuable paper, published in a journal that is little read, is here introduced to a much larger world.

**Pheretima (The Indian Earthworm)**
By Prof. Karm Narayan Bahl. (The Indian Zoological Memoirs on Indian Animal Types, 1.) Second edition, revised and enlarged. Pp. x + 85. (Lucknow: Lucknow Publishing House, 1936.) 1.8 rupees.

PROF. BAHL, the author of the memoir under notice, is also the general editor of this useful series. It is ten years since the first edition was published, and the relevant work done in the interval has been incorporated. The book has been thoroughly revised and to some extent rearranged. It is printed upon a more satisfactory paper, which does better justice to the illustrations. Five of the figures of the first edition have been omitted, nine new ones inserted and several have been redrawn, resulting in a distinct improvement. The brief account of the development has been omitted but an interesting new chapter on the receptor organs has been put in. The old chapter on habits and distribution has been rewritten and extended, and removed to near the end as "Bionomics, Distribution and Relationships".

The memoir was good when first issued and its usefulness is shown by the demand for a second edition. In its new form, where every chapter has been critically revised and added to, the illustrations improved, and the recent work included, it should be assured of a new lease of life.

C. H. O'D.

**Geologie Südamerikas**
Von Prof. Dr. H. Gerth. (Geologie der Erde, herausgegeben von Prof. Dr. Erich Krenkel.) Teil 2. Pp. vi + 201–389 + plates 18–30. (Berlin: Gebrüder Borntraeger, 1935.) 19.60 gold marks.

THE second part of Prof. Gerth's exceedingly useful treatise on the geology of South America deals with the geological history of the continent during Mesozoic times and summarizes, in a very concise manner, the rather scattered literature on the subject.

The method of treatment is similar to that employed so successfully by the author in vol. 1, and the regional discussion of each system or formation is followed by a short section dealing with the main events throughout the continent as a whole.

In contrast to the northern hemisphere, the Mesozoic era in the southern continent was a period of intense and widespread igneous activity which reached its maximum expression during the Trias but recurred locally during the Jurassic and Cretaceous. The author brings this igneous activity into line with the tectonic status of the continent and traces the development of the three great, independent zones of sedimentation from which the Tertiary orogenic zone developed.

The numerous correlation tables and abundant references to literature considerably increase the value of this excellent book, which must prove of interest and value to all geologists, and not merely to those directly concerned with the problems of South American geology.

**Beiträge zur Herkunftsbestimmung bei Honig**
Band 1: Pollengestaltung und Herkunftsbestimmung bei Blütenhonig; mit besonderer Berücksichtigung des Deutschen Trachtgebietes. Von Prof. Dr. Enoch Zander. Pp. 343 + 80 plates. (Berlin: Verlag der Reichsfachgruppe Imker E.V., 1935.) 18 gold marks.

HONEY contains large numbers of pollen grains of the blossoms visited by bees, and, consequently, a study of the pollen may yield considerable information as to the source of a honey sample—not only the flower-source, but perhaps also of the district or country of origin.

This volume contains an exhaustive account of the pollen forms that have been noted in German honey and also in occasional samples from other lands. Since the German and British floras have much in common, British students may find this work useful. Descriptions of the pollen of nearly six hundred species of plants belonging to 109 families are supplied, and pollen characters such as size, shape, number of pores and furrows are also marshalled in lists. Photographic illustrations of the pollen of nearly 350 species are also included in double-sided plates. These plates are disappointing. Each pollen form is generally shown twice, at magnifications of 160 and 450 times. For all but a small number of the larger pollen grains, the lower magnification is too low to give a picture of any value in a work of this kind, while even at the higher magnification details of diagnostic value are often obscure.

# Deterioration of Structures in Sea Water

NOT the least important of the matters which concern the civil engineer engaged on port and maritime works, such as docks, jetties, wharves and piers, is the durability in a marine environment of the materials available for constructional purposes. Timber, iron and steel and concrete immersed in sea water are exposed to the action of agencies producing damage and

FIG. 1. *Teredo navalis* and section of attacked timber.

deterioration to a far higher degree than those characteristic of a purely atmospheric environment. Timber is not only particularly prone to 'rot' or decay at or about the water-line, especially if that fluctuates in level, but also it is assailed by marine organisms of highly destructive capability, while the chemical action of the salts in sea water is equally potent, under suitable conditions, in causing and fostering corrosion in metals and disintegration in concrete. When, therefore, the Institution of Civil Engineers, in 1920, instituted a Committee of Inquiry into the Deterioration of Structures in Sea Water, it took a step which had long been desirable and which, it may confidently be asserted, has been of inestimable advantage both to the profession and to the public at large. An investigation of the kind in question is bound to be prolonged, since certain deleterious processes are slow in action, though their cumulative effect over a number of years may be extremely serious and even fatal. Each year, the Committee has published the results of its inquiries in the form of interim reports, and now it is felt that the time has come when it is fitting to issue a connected account of the whole of the investigations which have been carried out up to date, and the conclusions which, in the opinion of the Committee, may reasonably be drawn from the results so far obtained.

This has been done in a volume which has been published by the Department of Scientific and Industrial Research* embodying the fifteenth report of the Institution Committee, though the Department is careful to state that it is not responsible for the statements made or the opinions expressed therein. A similar disclaimer is made by the Institution as regards endorsing the views of contributors whose names appear in connexion with their work.

The Report comprises four sections, relating respectively to the preservation of timber, the corrosion of steel and iron, the protection of steel and iron by means of paints and other preservatives, and lastly, the deterioration of reinforced concrete.

Omitting decay, the principal cause of damage to timber structures in sea water is the *Teredo* or *Bankia*, commonly known as the ship-worm, and certain allied species (Fig. 1). The ravages of these molluscs were evident in the earliest days of ship-building, and they are recorded to have proved disastrous in the fourth voyage of Columbus, whose ships were "pierced with worm-holes like a bee-hive". At the present day, the damage done to timber piling in various parts of the world may be reckoned in millions of pounds. The Romans are stated to have made the discovery of a species of wood which is immune, but their secret is lost, and so far as current knowledge goes, there is no timber which is indubitably free from liability to be attacked. As the result of the experiments carried out, the Committee came to the conclusion that "no process for the preservation

* Department of Scientific and Industrial Research. Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea-Water. Fifteenth Report of the Committee of the Institution of Civil Engineers: being a General Description of the Experimental Work carried out by the Committee to date. Edited by S. M. Dixon and H. J. Grose. Pp. xvi + 136 + 60 plates. (London: H.M. Stationery Office. 1935.) 12s. 6d. net.

of timber was more satisfactory than that of impregnation with creosote" and that "the efficacy of the process depended on the completeness with which the penetration of the creosote into the timber had been effected".

In order to increase the degree of penetration, incision of the fibres was resorted to, and the results of the operation are stated to have been satisfactory, the depth of the penetration being governed by the depths of the incisions, which had to be limited "in some cases" because there was a danger of injuring the timbers if the depth of the incisions exceeded ¾ inch. The warning is significant, and there are those who will feel that incision is a method to be used with extreme caution, since injury to the fibres can scarcely be avoided, with consequent impairment of strength. The normal process of impregnation with hot creosote does not appear to affect the strength of timber to any material degree, though high temperatures were observed to produce some reduction of strength. The arsenical compound, chlorodihydrophenarsazine, commonly called "D.M.", proved very deadly to *Teredo* when in the state of free swimming larvæ. The experiments did not definitely show creosote to be an efficient protection in the case of crustaceans, such as *Limnoria*, though it appeared to have some useful effect against *Chelura*. Prof. G. Barger contributes a detailed account of his experiments with various toxins, and Prof. S. M. Dixon describes his mechanical tests of foreign timbers, untreated and creosoted, with a note on incising.

The corrosion of metals constitutes a wide field of inquiry in itself, and though in the present instance limited to iron and steel, specimen bars of no less than fourteen different materials were selected for experiment: these included three representative rolled irons, four ordinary steels, two types of cast iron and five special steels. In their choice of specimens, the Committee had the advice of Sir Robert Hadfield, and the examination of the bars after exposure was made by Dr. J. Newton Friend. The test specimens were in general 24 in. long by 3 in. by ½ in.

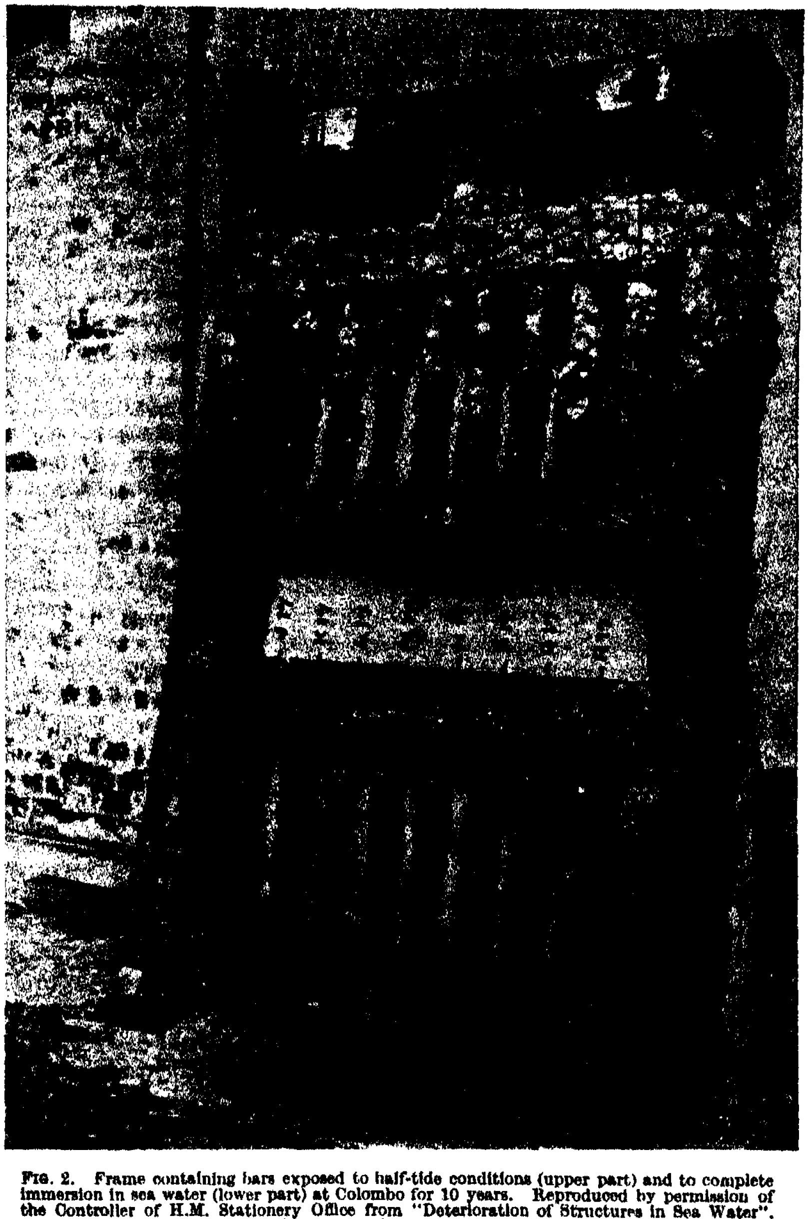

FIG. 2. Frame containing bars exposed to half-tide conditions (upper part) and to complete immersion in sea water (lower part) at Colombo for 10 years. Reproduced by permission of the Controller of H.M. Stationery Office from "Deterioration of Structures in Sea Water". Crown copyright reserved.

On the whole, there was found to be little to choose between the wrought irons and the ordinary carbon steels used in the research, as regards their mean resistance to the various types of corrosion studied; and increasing the carbon content of ordinary steel from about 0·24 to 0·40 per cent

did not appear appreciably to affect the resistance of the metal against corrosion. The addition of 0·6 and 2·2 per cent of copper to mild carbon steel markedly increased the resistance of the metal to aerial and freshwater corrosion, but this advantage did not appear to be maintained in the half-tide and complete immersion tests in sea water. The addition of chromium proved beneficial in the tests above high-water mark, but in the half-tide and complete immersion tests it resulted in excessive pitting. The best results were obtained by adding a proportion of nickel to the steel, an addition of 36·6 per cent rendering the material exceptionally resistant under all conditions. The cast irons resisted aerial corrosion exceedingly well and fresh-water reasonably well, but in the half-tide and complete immersion tests in sea water, corrosion frequently penetrated to the middle of the bars through pores and casting flaws. It is to be noted that the corrosion of the test bars was complicated by the occurrence of marine growths, including barnacles and oysters (Fig. 2).

The preservative effect of paints and other coatings on a number of mild steel plates (2 ft. long by 6 in. wide by about 0·1 in. thick) was studied, and the tests under the supervision of Dr. Newton Friend yielded results of much interest. The advantage of removing the mill-scale prior to coating, either by pickling or sand-blasting, was brought out clearly. Immersion in sea water and subsequent scraping was not so satisfactory. The plates were treated with red iron oxide paint (adopted as the standard for comparison) and with ordinary red lead paint with various $Pb_3O_4$ contents. The red lead paints showed distinct superiority in the aerial and half-tide experiments, but not in the total immersion tests. A series of plates were galvanized and a further set covered with tar and bituminous mixtures. Galvanizing proved very successful with a coating of about 20 oz. of zinc per square yard. Coal tar gave excellent results and proved in all circumstances much better than iron oxide and lead paints. Bituminous solution gave poor results in aerial tests, but excellent results in the half-tide and complete immersion tests.

The experimental investigation of the durability of reinforced concrete in sea water has been conducted by Dr. R. E. Stradling. The experiments have involved the preparation of 474 reinforced concrete piles and 5,388 cylinders of different composition and treatment. The longest period of exposure experienced by any of these series as yet is only 5¼ years, and it is therefore premature to draw other than merely tentative conclusions therefrom. As further examination may lead to modified views, it is scarcely advisable at this stage to do more than record the continuance of the exposure tests under various conditions at stations at Sheerness, Watford and the Gold Coast.

The volume, which is well illustrated and accompanied by diagrams and tables of great interest, will be of value to all who are in any way responsible for the maintenance of structures in a marine environment. It should be added that the research is now being carried on by means of the financial assistance received from a large number of dock and harbour authorities. There is a good index.

In connexion with the foregoing review, it is appropriate to notice a paper on "The Corrosion of Iron and Steel" by Sir Robert Hadfield and Mr. S. A. Main which was read at a meeting of the Institution of Civil Engineers on April 7. The paper was essentially an extension and amplification of the Committee's Report, in that it surveyed more completely the field of investigational activities in regard to the corrosion of ferrous metals since 1922, the date of a previous paper on the subject by Sir Robert Hadfield. Emphasis was laid on the importance of the study of corrosion from the testimony of Dr. F. N. Speller, director of research at the National Tube Company, Pittsburgh, U.S.A., who had made a careful estimate of the total amount of steel in use in the world and found it to be about 1,200 million tons, of which 700 million tons is probably in use in the United States. Dr. Speller further estimated that about 75 per cent of the steel requires protection in order to be used.

Alluding to the work of the Committee, it was stated that altogether 1,350 specimens of carbon and special steels were prepared by Messrs. Hadfields of Sheffield for experimental purposes, and that in regard to exposure to air, the order of increasing severity for general wastage at the stations selected for observation was invariably Halifax (Nova Scotia), Auckland, Plymouth and Colombo. Climatic temperature, which is highest at Colombo and lowest at Halifax, evidently must have a definite influence in promoting aerial corrosion. This factor, however, did not operate to the same extent under half-tide conditions or for total immersion: presumably, therefore, the local character of the sea water may be of more importance than its temperature. The evidence of the behaviour of iron and steel under half-tide conditions is especially instructive, being contrary to the widely accepted idea that exposure "between wind and water" is particularly favourable to corrosion. In the great majority of cases among ordinary steels and rolled irons, the wastage at half-tide is intermediate between that experienced under aerial and total immersion conditions.

The authors gave some examples of the severity

of the corrosion experienced in the Gulf of Paria, where the United British Oilfields of Trinidad, Ltd., reported that a 5/16 in. mild steel plate, forming the bottom of a storage tank, was eaten through in nine months. Among the protective measures discussed, special mention was made of oxide films, not more than 1·6 millionths of an inch in thickness, yet capable of providing an armour, or first line of defence against corrosion.

In most cases of general wastage of steel, the removal of the rolling-mill scale, prior to exposure, had the effect of increasing the amount of corrosion, but, on the other hand, as regards pitting, its influence was almost entirely favourable. The wastage of cast iron was generally very much less than that of the rolled irons and steels, and the pitting in a five-year test was negligible.

BRYSSON CUNNINGHAM.

# Insect Life of Temporary Rain Swamps in British Guiana

By F. A. Squire, Department of Agriculture, British Guiana

TWICE a year, during the months immediately preceding and following the solstices, the low-lying, badly drained grasslands of the coastal belt of British Guiana are converted into temporary swamps by the heavy rains which fall during those periods. This condition naturally varies a good deal in extent and duration, but generally lasts for at least several weeks. In that time the swamps become the home of innumerable insects of diverse species, some of them of the greatest concern to mankind, and all of them very interesting.

The following account is based on observations made during the mid-year rainy season of 1935. The rains commenced on May 16 and continued with daily precipitations and frequent heavy downpours up to the end of June, when dry spells began to intervene. Up to this point the season was typical, but an opportunity to prolong the investigation was afforded by an unusually wet July and August. The rainfall recorded at the Botanic Gardens, Georgetown, for the months in question was: May, 11·56 in., June, 14·37 in., July, 8·12 in. and August, 13·78 in., totalling 47·83 in. With the cessation of the rains, the swamps drain off and vanish almost as suddenly as they appear, so that there is never any stagnation.

Bearing in mind the abruptness of the onset of the rains, it is perhaps scarcely necessary to labour the point that when these aquatic conditions arise, there is a complete and somewhat sudden change in the savannah population—the dry season dwellers evacuating their territory with a good deal of haste and panic, and often with considerable loss of life. This is quite commonly observed in the case of *Solenopsis*, the red stinging ant. This notorious insect infests, and often monopolizes, the countryside—especially low-lying grasslands. Here it establishes its colonies in ever-increasing numbers, and it would, in a short time, surely become a terrible scourge but for the blessed ruthlessness of Nature. With the advent of the rains and the flooding of the savannahs, these colonies are promptly inundated. How the ant meets this parlous situation by forming living rafts for the purpose of salvaging the brood and fertile queens is well known. But how many of these castaways ever reach safety, and what is the extent of the subterranean mortality ?

Even more disastrous is the effect of the floods on other underground insects, especially the larvæ and pupæ of humous and root-feeding Coleoptera. These frequently have no aquatic adaptations, and are consequently easily overcome by excessive moisture. These inhabitants of the soil have, presumably through natural selection, come to pass their more defenceless stages during the dry seasons. But this arrangement is precarious, for the weather is often capricious, and unseasonable deluges not infrequently occur, creating very unfavourable conditions for the soil fauna. The Dynastids, *Dyscinetus geminatus* and *D. bidentatus*, in particular, are very adversely affected, and may be prevented from making their appearance in pestilential numbers for several years by such an occurrence. Tangible evidence of the havoc caused is not lacking, for the receding waters leave behind them innumerable dead grubs scattered over the countryside.

Above the ground another story is told. The rather populous Orthoptera and Hemiptera that may, in dry weather, be swept up from any patch of grass, are better equipped for flight to higher levels ; yet many are trapped, and may be seen clinging to a hopeful blade of grass or making sorry efforts to swim with ill-adapted limbs. There is, indeed, one local grasshopper which, I believe, must be unique, whose life is normally passed in semi-aquatic surroundings and whose hind-tibiæ are curiously suited to this element, being flattened and expanded to form paddles.

The disappearance of the dry season population with the advent of the rains is soon followed by the appearance of a number of bizarre water dwellers, the life of which, for the few weeks of the duration of the swamps, is a fierce internecine war. Among the first to colonize this new environment are the mosquitoes. The females continue to oviposit throughout the season, thus keeping the swamps well supplied with larvæ and pupæ of all ages. Yet this apparently ideal breeding ground is but a death trap for the species. The vast majority never reach maturity, but fall a prey either as larvæ or as pupæ to predacious insects. By far the most numerous species is *Culex similis* Theo. Also present, though in decidedly fewer numbers, is *Urotaenia lowii* Theo. *Anopheles tarsimaculata* Goeldi is found here and there in shady spots.

Chief among the natural enemies of the Culicidæ are dragonfly larvæ, of which about six different species were found. They are the most successful of the swamp fauna. This is due to their great agility, their cryptic patterns, their curious habit of camouflaging themselves with débris when at rest, and perhaps to their repulsive, spidery appearance. That they are not far more predominant is probably due to their deplorable cannibalism. While the young nymphs content themselves with mosquitoes, the larger instars are inclined to disdain this exiguous diet and go for members of their own family, which they disembowel with the movable hooks of their mask. Their cannibalism is, however, facultative; in fact, they have a catholic palate, and their diet includes tadpoles, two species of which swarm in the temporary swamps, young grubs of water-beetles, tabanid maggots and Belostomatidæ.

It is a noteworthy fact that these Odonata pass through their life-cycle quite comfortably during the short duration of the swamps. It seems that the long life-history ascribed to them in text-books is largely a laboratory fiction, as they do very poorly in captivity, even when natural conditions are closely simulated.

Two species in particular, *Erythrodiplax umbrata* Linn. and *Leptothemis vesiculosa* Fabr. were kept under observation in an aquarium. By far their most striking peculiarity is their habit of camouflaging themselves. They kick up the sediment, which settles in a fine shower on their limbs and body, and covers them like a mantle. In this manner they not only escape the unwelcome attentions of their enemies while resting or during moulting, but are also better able to seize their prey unexpectedly, thus securing an initial advantage in combat which may be sorely needed when the object of their designs is a well-matched nymph or a robust *Hydrous* grub.

Full-grown larvæ of *Hydrous* are never attacked, as they would be rather unmanageable, and a discreet preference is shown for harmless fare like tadpoles. These make easy prey, and are simply seized under the jaw and gnawed to pieces without being able to offer any resistance beyond an ineffectual wriggle. With this defenceless pabulum the dragonflies make merry, and for our immunity from at least one of the seven plagues of Egypt we owe a good deal to the Odonata.

In their turn, however, the Odonata are beset by rapacious foes. Among these the most fearsome is the silver water-beetle *Hydrous smaragdinous*. The adult is an inoffensive vegetarian, so that it is all the more surprising to find the larvæ equipped with a pair of huge crescentic jaws. Dragonfly nymphs, despite their superior agility and cryptic colouring, fall easy prey to these slug-like creatures which, covering themselves with fine mud, and moving slowly but quietly, are able to approach unobserved within striking distance of their quarry. Their favourite food is the tadpole, which is secured in an interesting manner: the tadpole, having the advantage of speed and elusiveness, is first of all rendered *hors de combat* by being deprived of its tail. In many cases this is accomplished by a single sweep of the great jaws, but where the victim is more robust, the amputation is not quite so artistic.

The life-history of the silver water-beetle is of unusual interest. The egg mass is approximately hemispherical and about ¾ in. in diameter. It consists of dry froth, with an outer impermeable crust. The flat side has a hardened, triangular pad which floats vertically with the apex up, and is invariably attached to a straw which serves to camouflage it. The eggs are pale yellow and about 4 mm. in length, and are placed vertically in the side of the hemisphere in a single layer of about three hundred. The rest of the space being taken up by froth, the centre of gravity is low, thus stabilizing the egg mass. More remarkable is the rapidity of the embryology: the eggs are laid within a day or two of mating and are quite undeveloped at oviposition; yet within three days the larvæ emerge. The outer envelope is ruptured round the base of the triangular pad and the grubs swim out. There are three casts, the first taking place two days after eclosion, the second about four days later, and the last before pupation, seventeen days after that. By this time the grub has attained a length of two inches. There is a quiescent prepupal stage of six days, followed by a pupal instar of five days. Thus the total life-cycle occupies about thirty-one days. Another water-beetle with similar biology occurring in the temporary swamps is *Tropisternus lævis* Sturm.

Other insects of interest in this association are the Belostomatidæ, of which several species occur. Their prey consists of mosquito, dragonfly and tabanid larvæ, which they seize with their prehensile forelegs.

In conclusion, attention may once more be directed to the rapidity with which the temporary swamps are colonized, and the intense and incessant competition among the colonists and its effect on the mosquito population. The comparative paucity of mosquitoes during the thick of the rains is a common experience in British Guiana, and is generally attributed to the destruction of larvæ by excessive flooding. While there may be something in this, there is little doubt that it is due in a far greater measure to the mosquito's aquatic associates. These are slower at colonizing at the onset of the rains, and cannot establish themselves at all in the ephemeral puddles that result from the intermittent showers towards the end of the season. This suggests a reason for the prevalence of mosquitoes at the beginning and at the end of the rains, and their scarcity when the rainy season is in full swing.

# Obituary

## Dr. W. J. S. Lockyer

THE sudden death of Dr. Lockyer has deprived astronomical circles of a familiar and welcome figure. While walking down to his house from the Norman Lockyer Observatory on July 15 he was seen to fall on his face; and when some men close by went to help him up, he was found to be dead. About two years ago he was laid up for several months on account of phlebitis, and his death seems to have been a sequel to this attack.

To all his friends, Dr. William James Stewart Lockyer was affectionately known as 'Jim', and by all of them he will be greatly missed. He was the fifth son of Sir Norman Lockyer and was born on January 3, 1868. His mother died when he was eleven years of age, and the present Lady Lockyer was married to Sir Norman in 1903. The stages of Dr. Lockyer's education at Cheltenham College, Trinity College, Cambridge, the Royal College of Science, South Kensington, and the University of Göttingen, all led naturally to a scientific career and to his carrying on the astronomical studies of his distinguished father. The subject of the thesis for which he received his doctorate at Göttingen in 1896 was the variable star $\eta$ Aquilæ, all the available observations of which he submitted to full discussion with some interesting conclusions. Among the results obtained was that the epoch of maximum luminosity oscillates to and fro to the extent of five hours on either side, with a period comprising four hundred maxima. The minima are also subject to a similar oscillation, and four secondary undulations were revealed on the curves representing the variability of the star's magnitude, recurring at intervals of forty-three hours, or one-quarter of the main period.

Variability of another kind, namely, that of the spectrum of the star $\gamma$ Cassiopeiia, was the subject of Dr. Lockyer's most recent papers to the Royal Astronomical Society. This star has a constant magnitude of 2·25, and its spectrum was also believed to be constant until a close examination of photographs taken by Dr. Lockyer proved it to change in a very peculiar manner. The spectrum contains hydrogen lines each made up of double emission lines superimposed on a broad absorption line. The two components of each of the double emission lines undergo regular changes of relative intensity; and in his last paper on this star, contributed to the Royal Astronomical Society a little more than a year ago, evidence was presented of some very remarkable variations of this character.

This paper was one of forty dealing with spectroscopic work carried out at the Norman Lockyer Observatory, Sidmouth, since 1920, nearly all of them by Dr. Lockyer himself. The Observatory was founded by Sir Norman with the help of sympathetic friends in 1912, after the decision to transfer to Cambridge the Solar Physics Observatory in which he had carried on astrophysical and astrochemical work continuously since 1875. It was first called the Hill Observatory, but was given its present name after Sir Norman's death in 1920. Four years earlier, the Norman Lockyer Observatory had been formed into a Corporation under the Companies (Consolidation) Act, 1908, with Sir Robert Mond, who was a school friend of Dr. Lockyer's at Cheltenham College, as chairman. Dr. Lockyer succeeded his father as director of the Observatory in 1920, and though he usually had only one assistant observer, the amount of original work done has been remarkable, with the result that the Observatory now possesses as fine a collection of photographs of stellar spectra as any observatory in Great Britain. Such a record is particularly good for an institution maintained entirely by private benefactors and without any State aid.

Both in association with his father, and separately, Dr. Lockyer took part in a number of total solar eclipse expeditions. Among these were Government expeditions to observe the Vadso (Lapland) eclipse of 1896; Viziadrug (India), 1898; Alicante (Spain), 1900; Palma (Majorca), 1905; and Vavau (Tonga Islands), 1911, when he was the chief of the expedition. Other eclipses observed by him were those of 1912 (France); 1921 (Scotland); 1927 (England);

and 1932 (Canada), and whenever weather conditions were favourable he was successful in adding something to our knowledge of solar phenomena revealed during totality. His skill as a photographer, and familiarity with astronomical instruments, made him particularly valuable to every eclipse expedition of which he was a member.

While certain problems relating to the constitution of the sun can only be studied during the brief moments of total eclipse, there are many others which require for their solution the collection of observations over a long period. Among these is the relation between solar changes and terrestrial weather, to which subject Sir Norman and his son contributed some notable papers. Upon the initiative of Sir Norman, a committee for the study of such changes was appointed by the International Meteorological Committee in 1903, and Dr. Lockyer became secretary of it. Periodic plus and minus 'pulses' of rainfall in India were described by Sir Norman and Dr. Lockyer in a paper read before the Royal Society in November 1900, and were shown to be related (sometimes inversely) to similar variations at Mauritius, Cordoba (South America), the Cape of Good Hope, and other places. Attention was afterwards devoted to an examination of the variations of pressure over the Indian and other areas, and a period of 3·8 years was found in the mean variation over the whole of India and the other areas. An inverse variation was found in the pressures at Cordoba ; in fact, there was a 'see-saw'. The area affected by this barometric see-saw was extended in a later paper before the Royal Society to Java, Ceylon, Mauritius and Australia.

These studies of periodic variations in the earth's meteorological elements are closely related to solar conditions. It was shown by Dr. Lockyer that, underlying the ordinary solar cycle of eleven years, there is another of greater length, namely, thirty-five years, or about three cycles of solar activity. This corresponds to Brückner's well-known climatic cycle of about thirty-five years, and thus associates weather changes on the earth with periodic variations of solar phenomena. What exactly is the relationship between the two sets of changes has yet to be determined, and the criterion of correlation coefficients has taken the place of that of curve parallels, but Dr. Lockyer's studies of the problem are still important contributions towards its solution.

Dr. Lockyer was keenly interested in aeronautics, and he made his first ascent in a balloon in 1907, with the late Hon. C. S. Rolls as pilot. For the next few years he was in the air in balloons and aeroplanes as often as his work or chance permitted, invariably accompanied by his camera and frequently with other scientific instruments, such as experimental direction finders and similar gadgets. During the Great War he was commissioned in July 1915 as a lieutenant in the Royal Naval Volunteer Reserve, attached to the Royal Naval Air Service, and two years later was promoted to the rank of lieutenant-commander. He served as commanding officer at several anti-Zeppelin stations and also in other capacities, such as intelligence officer to H.Q. Manston and Westgate R.N.A.S., ground instructor Netheravon (Wilts), and meteorological officer at Burnham Newton (Norfolk) and Orfordness (Suffolk). He became full major in the Royal Air Force in 1918 and was demobilized in August 1919, when he again took up his astronomical work.

Dr. Lockyer served on the Council of the Royal Astronomical Society from 1927 until 1929, and again from 1931 until the present year ; he was also a vice-president of the Society in the period 1933–35. He was honorary lecturer in astronomy at University College, Exeter, but most of his active life was devoted to observational work at South Kensington and later in the Observatory founded by his father on the top of Salcombe Hill, overlooking Sidmouth. He was married, and his widow survives him, but he leaves no children to continue or extend the work which has given the name of Lockyer a permanent place in the history of astronomical science. He will, however, not only be remembered in these records, but also by a large circle of personal friends, who will long cherish his memory with affection and esteem.

## Baron Axel von Klinckowström

The death of Baron Axel von Klinckowström, which occurred in the month of May at his home, the family estate of Stafsund on the island of Ekerö near Stockholm, removes one of the few remaining links with Nordenskiöld, the explorer. Klinckowström, who was born in 1867, accompanied Nordenskiöld to Spitsbergen in 1890 as a young zoologist, and in 1891 himself undertook a zoological expedition to Surinam. After his return, he devoted himself to biological research first at Stockholm and later at Würzburg under Sachs and Boveri. During those years he published a number of contributions to embryology, anatomy, variation and inheritance.

In 1895 Klinckowström was appointed University lecturer at Stockholm, and later undertook a number of expeditions to the Arctic and Antarctic. On his return he enriched the museums of Sweden by the presentation of his valuable collections. In his later years he devoted himself to bacteriological research carried out in his private laboratory at Stafsund. His many-sided interests embraced poetry and the history of art, and he was well known in Sweden as a writer of books of travel and adventure. His many friends will cherish the memory of a charming personality.

E. Kliennberger.

We regret to announce the following deaths :

Dr. Charles E. Johnson, director of the Roosevelt Wild Life Station at the New York State College of Forestry, on June 6, aged fifty-six years.

Prof. A. P. Karpinsky, president of the Academy of Sciences of the U.S.S.R., well known for his work in geology and palæontology, on July 14, aged eighty-nine years.

Prof. J. H. Müller, professor of chemistry of the University of Pennsylvania, an authority on the chemistry of germanium, on June 18, aged fifty-three years.

# News and Views

### The Medical Profession and Chemical Warfare

WE are glad that the British Medical Association, during the session held at Oxford on July 17–25, gave consideration, at the annual representative assembly on July 17, to the subject of chemical warfare. The Council of the Association reported that the question of the protection of the community against the effects of poison gas is being examined in connexion with the Air Raid Precautions Department of the Home Office before any definite proposals are made. After discussion of a resolution submitted by the North Glamorgan and Brecon Division of the Association, the following amendment was adopted: "That this meeting condemns unreservedly the use of poison gas in warfare as inhuman in its results and degrading to civilization, and relies upon the council to do everything in its power with a view to securing the co-operation of the medical profession in all countries in order to prohibit the use of poison gas." In the course of the discussion, an appeal was made to men of science generally, as well as to members of the medical profession, to protest collectively against the destruction of civilian populations through the use of poison gas, and to try to secure international co-operation with this end in view. Even though politicians may consider it impracticable to do anything to prohibit the destruction of human life by indiscriminate chemical warfare, yet scientific workers should let the community know that they dissociate themselves from the use of such methods. We hope therefore, that at the forthcoming meeting of the British Association at Blackpool the lead given by the British Medical Association will be followed; so that science may not be understood by silence as acquiescing in the application of its discoveries to the degradation of civilized life.

### Native Territories and the Union of South Africa

QUESTIONS in the House of Commons on July 16 indicated that no little consternation had been aroused in certain quarters by Mr. Pirow's statements on his return to South Africa as to the trend of opinion in Great Britain on the question of the future of African mandated territories. To some extent, this was allayed by the Prime Minister's assurance that Mr. Pirow's opinions are personal and that in any event, the question falling outside the scope of his mission, his view has no basis in official discussion. The House further elicited from the Under-Secretary of State for the Colonies an explanation of a somewhat cryptic statement by General Hertzog in the Union Parliament in making provision for an expenditure of £35,000 for "development and improvement in native territories", which has been taken, not unjustifiably, as pointing to the transfer of the native territories of Bechuanaland, Basutoland and Swaziland to the Union Government at no distant date, although the precedent condition of native consent, to which the British Government is pledged, is not yet fulfilled. Mr. MacDonald's reply clarified the situation. General Hertzog, it would appear, was defending an offer of the Union Government to contribute towards certain development schemes as a step towards the co-operation with the native authorities which has been agreed upon as a desirable policy. On July 15, Mr. MacDonald stated in a written reply that the offer of the Union Government is directed to three objects: (1) anti-soil erosion work in Basutoland, (2) provision of water supplies in Bechuanaland, and (3) conservation of water in Swaziland. Notwithstanding assurances that acceptance of the offer would not impair the pledges of His Majesty's Government in the United Kingdom, the uneasiness of the native authorities in the Protectorates is such that this offer is now in abeyance; but Mr. MacDonald stated that the question of assistance out of United Kingdom funds is under consideration by the Colonial Funds Development Committee.

### World Fellowship

A GENERAL meeting at Caxton Hall, Westminster, on July 18, concluded the proceedings of the World Congress of Faiths, which had been in session in London since July 3. On a broad view of the numerous contributions to discussion of world fellowship made by the delegates from the various faiths, it is evident that there is in each a body of opinion which is prepared to build upon the foundation of a common ethical element in an effort to co-operate in the solution of problems of a wider general application in present-day conditions. A spirit of good will and general agreement was perhaps more marked than any movement towards specific application at the moment; but it is, in any event, a distinct gain that an opportunity has been afforded a mixed assemblage to appreciate at first hand the distinctive outlook on, and approach to, the problems of the organization of life under different creeds and in various environments. Neither pious enthusiasm, however, nor even profound conviction, such as usually finds expression on these occasions, necessarily leads to tangible results; and to keep alive and give effect to the spirit of which the Congress has been a manifestation demands some channel through which it may be directed in order to avoid waste of energy. This aspect, happily, has not been overlooked in the present instance; and, at the last general meeting, the delegates decided to institute machinery to continue the work of spreading world fellowship through religion. It was agreed that all who presented papers, acted as chairmen, or led discussion, should form a council, and that a continuation committee should be appointed. The members then elected included Sir Francis Younghusband, Sir Herbert Samuel, Sir Sarvepalli Radhakrishnan, Mr. H. N. Spalding and Sir Abdul Qadir, with Mr. A. Jackman as secretary.

**New Heating Laboratory at the Building Research Station**

A NEW laboratory for research on the heating of buildings has been completed at the Building Research Station of the Department of Scientific and Industrial Research so that work can go on all the year round, instead of only in the winter. The laboratory was opened on July 22 by Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, on the occasion of the annual visit to the Building Research Station of the Institution of Heating and Ventilating Engineers, which is providing a sum of £1,500 to enable the studies, at the Station, of heating problems to be speeded up and extended. The laboratory is one room within a larger room. The smaller room, which is 18 ft. × 12 ft., is the test-room which is to be heated in all the different possible ways. It has a ceiling which can be screwed up or down so that both low rooms and high rooms can be studied. The larger room in which the test-room is situated isolates it completely from outside weather effects. The various walls of this outer enclosure can each be refrigerated and their temperatures can be controlled to 0·1° F. Modern heating methods have been utilized in the control of the outer enclosure. Every surface is panel-heated or panel-cooled by brine which circulates in pipes in the walls, floor and ceiling. For cooling the brine which refrigerates the walls, a 4½-ton ammonia compressor is installed in the engine-room at one end of the laboratory. At the other end of the laboratory is an instrument room, where records are made of the conditions in the test-room and its enclosure. The new laboratory provides unique facilities for research and will undoubtedly mean a great speeding up of heating research.

**Research and Finance**

IN the leading article in NATURE of July 11, there were, we regret to say, two inaccuracies which should be corrected. The system of grants in aid of the research associations and styled "the datum line system", described on p. 52, was superseded, some two years ago, by another system which, for the sake of brevity, may be called "the block grant system". The Department of Scientific and Industrial Research now makes an annual block grant to an association, provided that a definite sum is assured, in the form of subscriptions, by the industry concerned. The block grant and the industrial income have no rigid mathematical relationship; the ruling principle being that, added together, they must provide such a sum as will, in the opinion of the Advisory Council of the Department, form an adequate financial nucleus for a co-operative research organization for the industry in question. In order to encourage further expansion, the Department offers £ for £ on sums subscribed over and above the initial industrial income, up to a stated maximum, which, again, is fixed on the advice of the Advisory Council. This new system was the outcome of the big appeal made to industry a few years ago to play its part in expanding the operations of the research associations. The other inaccuracy was the parenthetical statement, on p. 52, that the woollen industry raises its contributions to co-operative research by means of a statutory levy. It is a fact that for some years now the woollen industry has been conducting propaganda in favour of the institution of such a statutory compulsory levy, but no measure for the attainment of this object has yet been introduced into Parliament. On the other hand, it may be remembered that a Rubber Industry Bill, having for its object the institution of a statutory levy, was introduced into Parliament and finally dropped owing to the defection of a prominent firm in the industry.

**Chamberlain Memorial at the University of Birmingham**

IN connexion with the centenary celebrations of the birth of Joseph Chamberlain, the first Chancellor of the University of Birmingham, Sir William Waters Butler has given £10,000 to provide scholarships, to be known as the Joseph Chamberlain Memorial scholarships. The University has also received a generous benefaction from Sir Charles Hyde, Bart., who has offered £10,000 towards the museum of the new Medical School, with the suggestion that this part of the new building should be known as the Chamberlain Memorial Museum. It is felt that this gift, like that of Sir William Butler, is very appropriate to the occasion; for it is well known that the University, of which Mr. Chamberlain was the founder and first Chancellor, occupied a foremost place in his regard, as being an essential part of the city for which he had done so much. His foresight in placing the new buildings in Edgbaston, where there would be ample room for expansion, has been notably justified in the event. It may well be that the most enduring monument to his name will be the University of Birmingham. Mr. Chamberlain's interest in medical research was made evident in the part he took in the establishment of the London and Liverpool Schools of Tropical Medicine.

**Roman Sites and the National Trust**

A NEW museum of Roman antiquities from Hadrian's Wall at Housesteads Camp, north-west of Hexham, was opened on July 23 by Prof. G. M. Trevelyan, vice-chairman of the National Trust. The cost of the building has been defrayed out of funds which have accumulated as a result of the greatly increased number of visitors, who now go to inspect the camp. In 1935 they numbered no less than 15,000. Housesteads, or Borcovicus, which on its north side abuts on the Wall, covers an area of five acres. It is not only one of the finest sites on the wall, but it is also one of the most completely excavated Roman camps open to view in Great Britain. During the excavations, a number of important finds were made, and these, with other antiquities, will be housed in the new museum. The site of five acres, a milecastle and three quarters of a mile of the wall itself were presented to the National Trust in 1930 by the owner, Mr. J. H. Clayton, a well-known Northumbrian antiquary. The site is now under the

management of a committee, the members of which include Prof. G. M. Trevelyan and Mr. J. A. Richmond, who for some years has been one of the most active of excavators on Roman sites in Britain. In this connexion may be mentioned another addition to the Roman sites held by the National Trust. Segontium, a Roman fort in Caernarvonshire, has been bequeathed to that body by Mr. John Roberts of London, a native of Caernarvon. The antiquities, pottery, coins and implements, which were found when the fort was excavated by Dr. R. E. Mortimer Wheeler in co-operation with the Office of Works, are housed in a museum which is bequeathed with the site.

### The National Trust

THE forty-first Annual Report of the National Trust for Places of Historic Interest or Natural Beauty for the year ending June 30, 1936, again chronicles a record increase in its work. Two years ago the Council reported a record addition to the properties of the Trust, and although the properties added to the holding this year are less spectacular in acreage, they are more numerous. In the two years taken together, the acreage owned or protected by the Trust has increased by nearly fifty per cent. While it may be concluded that this expansion in the operations of the Trust is an indication of an increase in public interest in the preservation of the natural beauty and historic interest of England, it is unfortunately also a gauge of the rapidity with which the threat of modern development is advancing over the countryside. Although it is true that many properties come to the Trust as the result of private benefaction by far-sighted owners, those which are acquired as the result of public appeal almost invariably are face to face with a threat of early destruction. As the Trust is able under its constitution to acquire and hold properties which are still in occupation, a sphere from which the Office of Works is barred by statute in the exercise of its function in protecting ancient monuments, the work of the National Trust is a very necessary supplement to official action, while the Trust itself is the most important, and in some cases the only, organization through which a national appeal can be launched effectively. It is gratifying to note that the Council is able to report the initiation of a scheme for the preservation of historic country houses and their contents, which adapts to English conditions the main principles of La Demeure Historique for the preservation of châteaux in France and Belgium.

### The Science Museum, South Kensington

THE Report of the Advisory Council of the Science Museum for 1935 has recently been published (London: H.M. Stationery Office. 1*s.* net). For the first time, the Report is signed by Sir Henry Lyons, who succeeded the late Sir Richard Glazebrook as chairman. Sir Richard served on the Council for twenty-three years and was chairman from 1931 until 1935, and the Report contains a tribute to the work he did for the Museum. There are to-day perhaps few Government institutions doing more within the scope of their activities, for education, scientific research and industrial progress, than the Science Museum, which has become a recognized centre for special exhibitions and scientific gatherings, and a place of popular instruction. During 1935, the total number of visitors rose to 1,327,190, the highest ever reached; 25,337 persons attended the public lectures, and 8,682 the special lectures, while in the galleries were held at various times excellent exhibitions relating to rubber, welding, noise-abatement, electro-deposition and air transport. The Report contains much evidence of the thought and work devoted to the acquisition and arrangement of the exhibits and of the logical illustration of the developments of physical science in all its branches. A special feature of the Report for 1935 is a detailed review of the collections in Division V, which include objects relating to physical phenomena, the structure of matter, magnetic, electrical, thermal and acoustical instruments, and the many branches of geophysics. Once again, the Council emphasizes the need for more accommodation, and the reconstruction of the central block. The present buildings in this portion of the Museum were built so long ago as 1862, and then only formed part of the temporary buildings for the Exhibition of that year. They are quite out of date, and their replacement is a matter of urgency if the Museum is to continue to make progress as it has done in the past.

### A New Fruit Juice Factory

FOR the past four years, intensive research work has been carried out at the University of Bristol Agricultural and Horticultural Research Station at Long Ashton into the possibility of utilizing surplus fruits from the various varieties of soft fruit grown in Great Britain by means of their conversion into liquid fruit products. The research work, which has been under the direction of Mr. V. L. S. Charley, B.Sc., has resulted in the production of a series of attractive products. H. W. Carter and Co., Ltd., of The Old Refinery, Bristol, 2, and 52 Queen Victoria Street, London, have now equipped the first factory of its kind in the country at North Street, Bedminster, Bristol, 3, to prepare these fruit syrups from English fruits, and a representative gathering met on July 15 to view the factory. The retention of the fresh flavour of English soft fruits when processed into a liquid form has been shown at Long Ashton to be largely a question of the amount of sugar which is incorporated with the juice. Fruit syrups with 65 per cent of sugar have been shown to be stable and to retain to a remarkable degree the true flavour of the fresh fruit. Such syrups, however, are not of general utility on account of their excessive sweetness, but if the sugar content is reduced to any appreciable extent, grave risks of fermentation and mould growth are incurred. However, it has been shown that pasteurization at 160° F. for half an hour, a treatment which is essential to obtain stability, does seriously affect the attractiveness of the finished product.

A PROCESS has therefore been evolved in which the fresh fruit juice is incorporated with sugar until

50–55° Brix is registered, and this unstable syrup is then preserved with 200–300 parts per million of sulphur dioxide in the form of potassium metabisulphite. The present syrups are intended for use primarily with milk, and it is necessary to avoid an excessively sweet product as this detracts not only from the milk flavour, but also tends to mask the fresh flavour of the fruit. The question of curdling is not serious until any addition of acid is carried out. Even with the highly acid juices of the loganberry and blackcurrant there is very little fear of curdling when the normal concentrations, which are generally acepted in the milk bars, are used. A further process of interest is the adaptation of the carefully controlled fermentation in the fruit. This fermentation is effective first in completely disintegrating the cells which thus yield a richer, sweeter juice and, secondly, in decomposing a certain amount of pectin which would otherwise be deposited in the filtered product. Remarkable results have recently been obtained by the use of pectin-decomposing enzymes in which an addition of 0·2 per cent of enzyme has reduced the calcium pectate content of the juice from 0·134 per cent to a mere trace.

### The Kauri

A SMALL pamphlet, Leaflet No. 26, on "The Properties and Uses of Kauri", *Agathis australis*, by A. R. Entrican, has been issued (Government Printer, Wellington, N.Z., 1935). This timber is one of the most useful of the coniferous softwoods, and has been known in international trade for more than a century. The kauri is the monarch of the New Zealand forests, dwarfing all other species. The bole in mature trees has singularly little taper; thus, although it does not attain the height of the North American redwoods (*Sequoia*) and the Australian eucalypts, it ranks among the largest timber-producing species in the world. It is said that in yielding flawless timber of exceptionally large size, the tree is unsurpassed by any other known species. The extensive virgin forests of the early European occupation have been severely depleted, but it is of good hope for the future to hear that the remaining stands are being placed under a system of forest regulations whereby a sustained yield of this valuable softwood will be assured. Owing to its evenness of texture and ease of working, to its small shrinkage powers, medium density and excellent strength properties and high durability, the timber is able to meet the most exacting requirements. It is made use of in all classes of building and general construction, in shipbuilding, car and wagon construction, tank and vat manufacture, military bridging, and the production of dairy and agricultural machinery and so forth. It is not surprising, as has been the case with fine species in other countries, that the brunt of the fellings for ordinary utilization by the increasing population of the country fell upon this beautiful tree.

### The National Institute of Agricultural Botany

AT the annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge on July 16, the chairman of the Council, Sir Daniel Hall, in the course of his address, stated that one of the primary objects of the Institute is to serve as a medium for introducing new varieties of farm crops to the public. For this purpose its trials are organized so as to provide an accurate measure of the relative merits or de-merits of each variety tested. These trials extend over three years or more, in order to level out weather differences, and are carried out at six different centres in order to eliminate differences due to soil variations. The improvements already effected in the yield of cereals make it unlikely that any new variety will show a 20 per cent improvement upon the existing varieties. Improvements in the nature of 5–10 per cent are more probable, but even a 5 per cent improvement would make a considerable financial difference to farmers. Farming is never at a standstill, and the Institute meets the changing agricultural situation by extending the scope of its trials. Trials of picking peas and chicory are now being carried out, and it is hoped that useful information will be derived from them. The potato trials at Ormskirk have done much to check the spread of wart disease by the encouragement given to the introduction of new immune varieties. Sir Daniel went on to say that close co-operation with the seed trade would be beneficial to both bodies. In serving the farmers, the Institute also serves the best interests of the seed trade, which has the highest degree of confidence in the Official Seed Testing Station. This is testified by the fact that the number of samples tested by the Official Seed Testing Station is steadily increasing year by year, and nearly 30,000 samples have been tested in the current year. In conclusion Sir Daniel expressed concern at the shrinkage in the number of fellows of the Institute: he hopes the Institute will never become a purely bureaucratic body, reponsible only to the Government.

### Prevention of Tuberculosis

SIR KINGSLEY WOOD, the Minister of Health, inaugurated the twenty-second annual conference of the National Association for the Prevention of Tuberculosis at the County Hall, London, on July 16. He stated that great progress has been made in the fight against tuberculosis. For the first time on record, the total number of deaths in England and Wales from all forms of tuberculosis fell in 1935 below 30,000. The standardized death-rate from tuberculosis has fallen from 1,915 to 687 per million in less than forty years. This striking record of progress is due in the first place to remarkable improvements in methods of treatment. Much also is due to the example given by the establishment, as a result of greater knowledge and active propaganda, of voluntary sanatoria and dispensaries. It is significant that no sanatorium in the modern sense existed in Great Britain before 1898. Improved standards of living and hygiene, better housing, better nutrition, purer milk supply and general public health measures have played and will continue to play a considerable part in the attack upon this disease. But there are many opportunities for further advance. There is a great need for encouraging those who were suffering or

suspected to be suffering from tuberculosis to take advantage at the earliest possible stage of the facilities provided for diagnosis and treatment. The importance also of eliminating tuberculous cattle from the herds of Great Britain is obviously very great. Bovine tuberculosis is responsible in Great Britain for a large number of deaths, probably more than 2,500 per annum, and for a still larger amount of serious illness. Much remains to be done before we can be satisfied that the whole of our milk supply is safe.

### British School of Archæology at Athens

ON October 13, the British School of Archæology at Athens will celebrate the fiftieth anniversary of its foundation by holding at the Royal Academy of Arts, Burlington House, an exhibition to illustrate the discoveries in Greece and Crete which have resulted from the work of the School, together with a special exhibit devoted to the Minoan civilizations of Greece, and the excavations of the School's honorary student, Sir Arthur Evans, at Knossos, in which the School's architects took part. This exhibit is being prepared by Sir Arthur Evans himself, with facilities kindly given him by the Keeper and Visitors of the Ashmolean Museum. It is understood that the exhibition will be inaugurated by His Royal Highness the Duke of Kent, on October 13 at 3 p.m., and will be open to the public from October 14 until November 14. In connexion with the jubilee of the School, it is proposed also to raise a special fund to enable the School to increase its staff, improve its library and accommodation, and provide for the needs of the graduate students who, in increasing numbers, are sent to Greece for advanced study by the universities.

### Indian Vital Statistics for 1933

THE chief vital statistical figures for British India for 1933 are: (1) total births, 9,678,876, giving a crude birth-rate of 35·5 per mille, (2) total deaths numbered 6,096,787, giving a crude death-rate of 22·4 per mille, (3) infantile deaths numbered 1,650,973, an infantile death-rate per 1,000 births of 170·5 (Ann. Rep. of the Public Health Commissioner with the Government of India for 1933. Government of India Press, New Delhi. Rs.6 as.4 or 10s.). The birth-rate is more than double, the death-rate nearly double, and the infant mortality about two and a half times, the corresponding figures for England and Wales. It is remarked that, contrary to some recent statements, the population of India is increasing at an alarming rate, and by 1941 will probably reach 400 millions. The total land area of British India amounts to only 2·44 acres per head of the population, but allowing for forest, uncultivated and fallow lands, only 0·72 acre per head is under food crops—quite insufficient for even the present population. Birth-control is viewed sympathetically, but only seven hundred medical women are available to instruct Indian women about it. Cholera deaths (68,816) and plague deaths (43,000) are not nearly so high as in some years, but smallpox deaths numbered 103,000, compared with 45,000 during the previous year—a disconcerting rise.

### Anti-Rabic Treatment in Southern India

THE Annual Report of the Director, Major Iyengar, of the Pasteur Institute of Southern India, Coonoor, states that during the year ended December 31, 1934, 414 persons underwent the complete, and 77 an incomplete, treatment at the Institute after bites by animals supposedly rabid. For the second time in the twenty-eight years of the Institute's existence, there were no deaths from hydrophobia among those treated. Paris fixed virus was in use in the form of Semple's carbolized five per cent sheep vaccine, and at the end of the year was in its 937 passage. The vaccine was also issued from several out-centres—12,316 courses for nearly 13,000 cases, with 26 deaths from hydrophobia. In addition, anti-rabic vaccine was issued for the prophylactic treatment of 259 animals. In spite of what the Institute is doing, 412 deaths from hydrophobia were recorded in the Madras Presidency during 1934.

### Northern Lights

PROF. CARL STØRMER has directed attention to a prevalent confusion between the north magnetic pole and the point on the earth where the magnetic axis meets the surface. Thus, in the supplement to NATURE of May 16, 1936, it is stated on p. 813 that "It is the distance from the magnetic axis of the earth that counts, and that axis meets the surface of the earth at the north magnetic pole, which is in the island of Boothia in Canada"; this should read as follows: "It is the distance from the magnetic axis of the earth that counts and that axis meets the surface of the earth about midway between the north magnetic pole and the north pole". This point is near North-Western Greenland, and it might be named the north axial pole. The zone or belt of greatest auroral display has this point for centre on the earth.

### The Night Sky in August

THE nights during August are still rather short to afford much opportunity for a close scrutiny of the rich fields about the galactic equator, which in the British Isles passes overhead from north-east to south-west about midnight at the beginning of the month. Even at nightfall, however, the sky is distinctive with Arcturus still fairly high towards the west: Jupiter a brilliant object in the south-west: Vega, Deneb and Altair not far from the meridian: Saturn rising with Pisces in the east, whilst Capella may be picked out towards the northern horizon. Full moon occurs on August $3^{d}\ 3^{h}\ 47^{m}$ and new moon on August $17^{d}\ 3^{h}\ 21^{m}$. The brightest star to be occulted this lunation is $\kappa$ Piscium (magnitude 4·9)—the reappearance may be observed on August $6^{d}\ 1^{h}\ 59{\cdot}7^{m}$ (U.T.) at position angle 267° from the north point of the lunar disk. Other occultations of stars, ranging in magnitude from 6·3 to 6·7, may be observed on August 5, 6, 10 and 13. Between August 9 and 12 occurs the maximum of the Perseid meteor shower, the radiant of which is in Perseus at R.A. $3^{h}\ 0^{m}$ and Dec. 57° N. The meteors of this shower are yellowish in colour and move with medium velocity. The orbit of the shower is well determined and coincides with

that of Tuttle's Comet of 1862. On August 4, Peltier's comet (discovered on May 15 last by Mr. L. Peltier of Delphos, Ohio) is at its nearest approach to the earth at a distance of 15¾ million miles. Its computed position on August $4^d$ $0^h$ is R.A. $21^h$ $45^m$ $10^s$: Dec. 4° 8′ S., which places it in the constellation Aquarius, but the moon being full will prevent its being easily observed; otherwise it should be faintly visible to the naked eye. The comet is then travelling south rapidly and will reach 70° S. on August 24. Nova Lacertæ, which was discovered on June $18^d$ $21\frac{1}{2}^h$, probably reached its maximum brightness of about mag. 2·2 on June 20 and is now slowly fading. Its magnitude on July 17 was 6·3 according to Steavenson, so that the nova can be seen with binoculars; its position (R.A. $22^h$ $11^m$ $5^s$: Dec. 54° 59′ 42″ N.) is about 2° south of ε Cephei. The character of the nova's spectrum suggests a more rapid progress than is normally the case through the typical evolution stages of a nova.

### Announcements

IN view of the Coronation festivities next year, the dates of the Royal Society soirées have been fixed well in advance. The men's soirée will be held on Tuesday, May 4, and the ladies' soirée on Thursday, May 6; it is possible that a third soirée will be arranged, but the date is not yet fixed.

IN connexion with the Second International Congress for Microbiology being held at University College, London, on July 25–August 1, an exhibition of scientific instruments has been arranged at the College. The exhibition will be open to all scientific workers, irrespective of whether they are members of the Congress or not, on July 27–29, from 10.30 a.m. until 5 p.m.

AT the Annual Summer Conference of Advisory Plant Pathologists at the University of Leeds, Dr. Geo. H. Pethybridge, mycologist to the Ministry of Agriculture and Fisheries for the last twelve years, and previously for many years in the Department of Agriculture in Ireland, was presented with a wireless receiving set, etc., as a mark of appreciation on the occasion of his approaching retirement from official service.

THE Jones-Bateman cup of the Royal Horticultural Society, which is awarded triennially for researches in the growing of hardy fruits, figs, grapes and peaches in the open or under glass, is available for award in 1936. Candidates should submit accounts of their work by October 31 to the Royal Horticultural Society, Vincent Square, Westminster, S.W.1. The work dealt with must have been carried out by the candidate in the United Kingdom mainly during the past five years.

THE thirteenth Annual Conference of the Association of Special Libraries and Information Bureaux (ASLIB) will be held in Oxford on September 18–21. On September 18, at 8.30 p.m., the president-elect, Dr. Cyril Norwood, will deliver his address entitled "The Library in the School". On September 19, at 9.30 a.m., a symposium on "Library Instruction for University and Research Students in America" will be held. Further information can be obtained from the General Secretary, ASLIB, 31, Museum Street, London, W.C.1.

PROF. E. ABDERHALDEN, professor of physiology in the University of Halle, has been nominated an honorary member of the Society of Biological Chemists at Bangalore.

THE following have recently been elected members of the Imperial Leopold Caroline German Academy of Science at Halle: Dr. Paul Buchner, professor of zoology at Leipzig; Dr. Hermann Loescheke, professor of pathology at Greifswald; Dr. C. Gösta A. Forsell, professor of medical radiology, and Dr. S. E. Patrik Haglund, professor of orthopædics at Stockholm; Dr. Knud Faber, professor of medicine at Copenhagen; Dr. A. H. M. J. Van Rooy, professor of gynæcology and obstetrics at Amsterdam; Dr. E. Leclainche, director of the international office of epizootics in Paris; and Dr. Karl Wegelin, professor of general pathology and morbid anatomy at Bern.

THE following scientific awards have recently been made by the American Medical Association: Gold Medal to Drs. Charles B. Huggins, S. W. J. Noonan and B. H. Blockson of the University of Chicago for their work in connexion with increasing blood production in the arms and legs by means of increased temperature; Silver Medal to G. C. Supple and S. Ansbacher of the research division of the Borden Company for their method of obtaining lactoflavine from milk; Bronze Medal to Dr. Alvin L. Barach of the Presbyterian Hospital, New York, for his method of providing an artificial light air in which helium is substituted for nitrogen.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A teacher of engineering (mechanical) in the Norwich Technical College—The Principal (July 28).

A lecturer in civil engineering in Armstrong College, Newcastle-upon-Tyne—The Registrar (July 30).

A statistician for a War Department establishment—The President, Royal Engineer Board, Regent's Park Barracks, London, N.W.1 (August 5).

Chemists at the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (August 7).

A senior lecturer in physiology in the University of Aberdeen—The Secretary (August 15).

A technical editor at the Technical Institute, 16 St. Mary's Parsonage, Manchester, 3—The General Secretary (September 7).

An assistant lecturer in the Department of Electrical Engineering, Mathematics and Physics (with engineering degree) in the Natal Technical College—Mr. H. W. Gray, 17 Claydon Avenue, Southsea.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 169.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Order of Affinity of Metals for Copper, Iron, Cobalt and Nickel

EACH of the metals aluminium, zinc, cadmium, tin, mercury and lead is known from X-ray and thermal data to form intermetallic compounds with copper. Some of these may be prepared also by obtaining the two metals in dilute solution or suspension (1–4 per cent) at the ordinary temperature in mercury and removing excess of the more reactive metal by oxidation and the mercury by filtration and distillation[1]. In mercury, under such conditions, there is in each system a binary compound much stabler than the others, namely, $AlCu_4$, $Sn_4Cu_4$, $ZnCu$, $CdCu_4$, $Hg_3Cu$. The question arises: Suppose we have two of the above metals competing for copper in the medium of mercury, do both combine with copper or does one only? Or, suppose we add one metal to the compound of another metal and copper, is there a partial reaction, or does the reaction go either completely or not at all?

The analytical difficulties of this problem are not serious, and it is possible to obtain unambiguous answers to these questions. There seems to be a definite order of the above metals with respect to their power to combine with copper. It is aluminium, tin, zinc, cadmium and mercury, lead. If copper be competed for by two of these metals, the one earlier in the list combines with it, the other remains uncombined. If a metal earlier in the list be added to a compound of copper and another of these metals, the former displaces the latter completely. If the positions are reversed, no reaction occurs. Thus, when aluminium is added to any tin, zinc, cadmium or lead compound of copper, in mercury, it combines with the copper and sets the other metal free. The resulting binary is $AlCu_4$ or, more often, the stabler ternary $Al_2Cu_3Hg_2$. From neither of these can the aluminium be displaced by any of the metals mentioned. So for the action of tin on zinc-copper compounds. Ternary and even quaternary complexes are temporarily formed[2], but in the end the zinc is wholly displaced and the tin combines with the copper. Ternaries throughout complicate the issue.

Similar experiments have been done with these metals and the metals iron, cobalt and nickel, with which each of them is also known to combine. With iron the stablest compounds formed are $AlFe_3$, $SnFe_2$, $ZnFe_7$ and $HgFe_4$ (cadmium and lead do not readily combine in mercury with transition elements). The order here is aluminium, tin, zinc, mercury, cadmium and lead. Thus, neither tin nor zinc can displace aluminium from $AlFe_3$, whereas the easiest way of preparing this compound is by adding aluminium to a tin-iron or a zinc-iron compound in mercury. With cobalt the stablest compounds formed are $AlCo$, $SnCo_2$, $ZnCo$ and $HgCo$; with nickel the stablest compounds are $AlNi$, $Sn_4Ni_3$, $ZnNi$ and $HgNi$. With both these metals the order is that obtained with iron and slightly different from that obtained with copper. The corresponding experiments with manganese and silver have still to be done. The inverse problem—How does one of the metals aluminium, tin and so on, distribute itself among the other metals of the class copper, silver, iron and so on?—is analytically very hard and has not yet been solved.

The order of metals obtained in these experiments is not, and would not be expected to be, that of the electrode-potential series, because in entering into intermetallic combination the atom does not undergo the simple process of ionization of the type $X \rightarrow X^+$. It is likely to be connected with atomic diameters and interatomic distances and forces in the crystal patterns formed.

A. S. RUSSELL.

Christ Church, Oxford.
July 4.

[1] Russell and others, *J. Chem. Soc.*, 841, 852, 857, 2340 (1932); 1750 (1934).
[2] Russell, NATURE, 133, 217 (1934).

## Formation of Carbon Dendrites

PARTICLES of colloidal graphitic oxide dispersed in water have a negative charge, and under a potential gradient move relatively rapidly towards the anode[1]. Under certain conditions, however, reduction of the oxide occurs at the cathode, with the formation of long carbon dendrites. This phenomenon was shown in striking manner under the following conditions.

Graphitic oxide was prepared from finely divided Ceylon graphite by treatment with the usual sulphuric, nitric acid, potassium chlorate mixture and the product washed with water. After five washings, the colloidal, supernatant, slightly viscous, brown opalescent solution (pH 2·88) was decanted into an inclined glass tube provided with two platinum electrodes (see Fig. 1). On applying a potential of approximately 200 volts between the electrodes, the disordered micellar lamellæ orientated themselves so that their faces were at right angles to the path between the electrodes (cf. Thiele[1]), and immediately thin carbon dendrites commenced to grow from the cathode, and the colloid started to collect round the anode.

These effects are clearly shown in Fig. 1 (*A*), which was made one second after switching on the potential. They have become much more pronounced 25 sec.

later, as is shown in *B*. *C* is a reproduction of a photograph of another tube through which current has passed for five minutes. The region of high colloid concentration can now be seen extending from the anode to the deposited carbon. Soon after this phase, the region of high colloid concentration assumed an almost rope-like appearance, connecting anode and cathode. Dendrite growth then became extremely rapid and in a few seconds the colloidal mass was reduced to carbon. *D* shows the final phase; some of the deposited carbon has floated to the top of the tube. During the whole process the potential across the tube did not vary by more than 20 volts, nor did the current exceed more than a few milliamperes. A few small bubbles of gas were liberated at both electrodes during the experiment. *E* shows carbon dendrites which have been formed in a vertical tube.

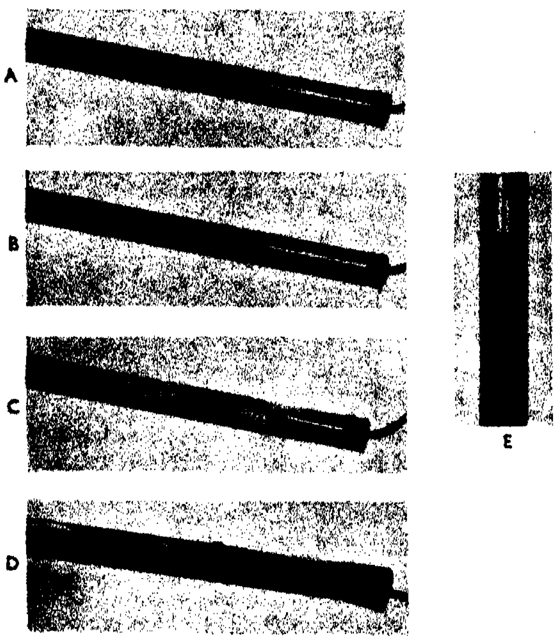

FIG. 1.

It is remarkable that in spite of the high repulsive force which the cathode must exert on the graphitic oxide particles, the latter can remain for a sufficiently long period in contact with the electrode for reduction to occur and for the resulting carbon to attach itself to the electrode. A more detailed examination of the phenomenon is being made.

K. D. LUKE.
W. M. MADGIN.
H. L. RILEY.
Armstrong College,
Newcastle-upon-Tyne.

[1] H. Thiele, *Z. anorg. Chem.*, 190, 145 (1930); *Koll. Z.*, 56, 129 (1931).

## A New Process of Negative Ion Formation

WHEN a stream of electrons is passed through a monatomic gas, negative ions are supposed to be formed by direct electron attachment to atoms of the gas with radiation of the excess energy. When the gas is molecular, the process generally presumed to occur is simultaneous dissociation of the molecule and attachment of the electron to one of the products of dissociation, the energy of the electron in excess of that necessary for dissociation together with the electron affinity of the atom being carried away in kinetic form by the products of dissociation.

| Process | Probability × $10^4$ | Process | Probability × $10^4$ |
|---|---|---|---|
| $Hg^+ \rightarrow Hg^-$ | 6·4 | $CO_2^+ \rightarrow CO_2^-$ | 2·31 |
| $H_2^+ \rightarrow H^-$ | 0·104 | $CO_2^+ + CO^+ \rightarrow CO^-$ | 10·8 |
| $N^+ \rightarrow N^-$ | 1·07 | $CO_2^+ \rightarrow O_2^-$ | 2·51 |
| $O_2^+ \rightarrow O_2^-$ | 0·42 | $CO_2^+ + CO^+ \rightarrow O^-$ | 3·37 |
| $O_2^+ \rightarrow O^-$ | 1·10 | $CO_2^+ + CO^+ \rightarrow C^-$ | 0·1 |

I have made an investigation of negative ion formation in mercury vapour, hydrogen, nitrogen, oxygen and carbon dioxide, and I find that the large majority, if not all, the negative ions detected are formed by a new process, and not by either of the processes mentioned above. The negative ions are formed from positive ions which extract two electrons from any negatively charged electrode, including the filament, to which they are driven. This process is energetically possible provided the sum of the ionization potential of the positive ion and the electron affinity of the negative ion that is formed is greater than twice the work function of the surface upon which the conversion takes place. The excess energy is probably dissipated by a collision of the second kind with an electron or atom of the surface.

Sometimes the positive ion is dissociated by its collision with the surface. The negative ion then formed is one of the products of dissociation. For example, the negative ions detected in carbon dioxide are $CO_2^-$, $CO^-$, $O_2^-$, $O^-$ and $C^-$. In oxygen, both $O_2^-$ and $O^-$ are found. Mercury vapour, hydrogen and nitrogen gave only the atomic negative ion.

The probability of conversion of positive ions into negative ions on a nickel surface has been measured as a function of the kinetic energy of the positive ions. In each gas the probability increases as the energy of the positive ion is increased. The probability of conversion of a 180-volt positive ion into a negative ion is given in the accompanying table in units of $10^{-4}$.

The negative ions come off the surface on which they are formed with a wide range of energy. From the energy distribution curves, values of the mean and the minimum accommodation coefficients for positive ions have been obtained. The energy distribution curve itself represents the probability distribution of the accommodation coefficient.

The fact that positive ions are converted into negative ions on negatively charged electrodes with the comparatively high probability shown in the above table introduces a serious, and hitherto unrecognized, source of error into many experiments, such as the recent work of Davies[1] on ionization produced by positive ions.

A complete account of this work will be published in the *Proceedings of the Royal Society*. The work on mercury vapour is already in the press, and should appear shortly.

F. L. ARNOT.
University,
St. Andrews.

[1] A. C. Davies, *Proc. Roy. Soc.*, A, 155, 123 (1936).

## The Form of Nuclear Levels

RECENT experimental work has proved the existence of selective absorption for neutrons the kinetic energy of which amounts to a few volts by certain nuclei[1-5]. Bohr[6] assumes that in these cases the kinetic energy of the captured neutron is equal to the difference between the energy of a level of the newly-formed nucleus and the mass defect for a neutron with zero velocity. This provides an ideal compensation method for the determination of the distance[7], breadth[5,7] and form of nuclear levels. The total energy of the level, which amounts in all these cases to some millions of volts, does not interfere with the determinations in question, since only the kinetic energy of the absorbed neutrons is measured.

When working with the cadmium filtered radiation of a source of slow neutrons, we observed big deviations from the exponential law for the absorption of resonance neutrons of rhodium (45 sec.) by rhodium and of resonance neutrons of iodine by iodine. In the accompanying table, $\mu$ means the mass absorption coefficient for the total absorption, $\mu'$ the mass absorption coefficient for each additional absorbing sheet :

| | Detector Rh (45 sec.), absorber Rh | | | | | Detector I, absorber I | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Absorber gm./cm.² | 0·01 | 0·02 | 0·04 | 0·08 | 0·18 | 0·2 | 0·5 | 0·8 | 1·8 | 3·1 |
| Absorption per cent | 16 | 24 | 31 | 44 | 52 | 27 | 45 | 53 | 58 | 02 |
| $\mu$ | 17 | 14 | 9 | 7 | 4 | 1·6 | 1·2 | 1·0 | 0·5 | 0·3 |
| $\mu'$ | 17 | 10 | 5 | 5 | 1·6 | 1·6 | 0·9 | 0·5 | 0·1 | 0·07 |

Since the cross-sections of boron for radiation filtered by 0·2 gm./cm.² of rhodium and detected by rhodium (45 sec.) or filtered by 3 gm./cm.² of iodine and detected by iodine, were identical with the cross-sections for the unfiltered radiations, the observed deviations cannot be explained by the existence of a second level for selective neutron absorption, as in the case of silver[1,7]. We think the explanation lies in the self-reversal of the nuclear line. When both the absorption coefficient and the intensity of emission have a maximum for exactly the same energy, the middle of the line will be totally extinguished after passage through a sufficient layer of the absorber, that which penetrates consisting only of the weakly absorbable tails. By determining the absorption coefficient for each additional layer of the

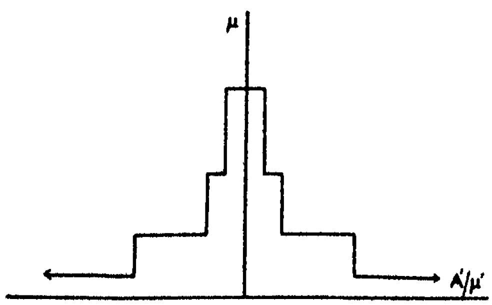


FIG. 1.

absorber, the whole range of values for the absorption coefficient between the middle of the line and the tails is obtained. We are thus able to determine the form of the nuclear levels. A detailed analysis and a comparison with the theoretical results of Breit and Wigner[8] will be given later. Qualitatively, the intensity distribution in the line is already obtained by plotting $\mu$ against $A'/\mu'$, $A'$ being the fraction of the total radiation which is absorbed by each sheet. Fig. 1 shows the result for rhodium (45 sec.) plotted in this way. The real form of the line shows somewhat bigger differences of intensity. The half-value breadth amounts, as was shown by other experiments, to about 0·25 volt.

*Errata :* There was a mistake in the calculations for $\mu_B$ and the energies of the levels iodine and bromine (18 min.) in our letter in NATURE of May 30, p. 905. The correct values are : Iodine, $\mu_B = 0{\cdot}7$, energy $= 75 \pm 15$ volts. Bromine (18 min.) $\mu_B = 0{\cdot}35$, energy $= 300 \pm 80$ volts. The results for silver and rhodium are correct.

PETER PREISWERK.
HANS VON HALBAN, JUN.

Institut du Radium,
Laboratoire Curie,
Paris.
June 6.

[1] Amaldi and Fermi, *Ric. Scient.*, VI, **2**, 346 and 448 (1936).
[2] L. Szilard, NATURE, **136**, 950 (1935).
[3] Frisch, v. Hevesy and McKay, NATURE, **137**, 149 (1936).
[4] Frisch and Plazcek, NATURE, **137**, 357 (1936).
[5] v. Halban and Preiswerk, *Compt. rend.*, **202**, 133 and 849 (1936). NATURE, **137**, 905 (1936). *Helv. Phys. Acta*, **518** (1936).
[6] N. Bohr, NATURE, **137**, 344 (1936).
[7] E. Amaldi and E. Fermi, *Ric. Scient.*, VII, 1, n. 7–8.
[8] G. Breit and E. Wigner, *Phys. Rev.*, **49**, 519 (1936).

## The Crystal Photo-effect and Rectifying Action in the Bulk of the Crystal

ATTEMPTS have been made to discover how far a rectifying action is connected with the crystal

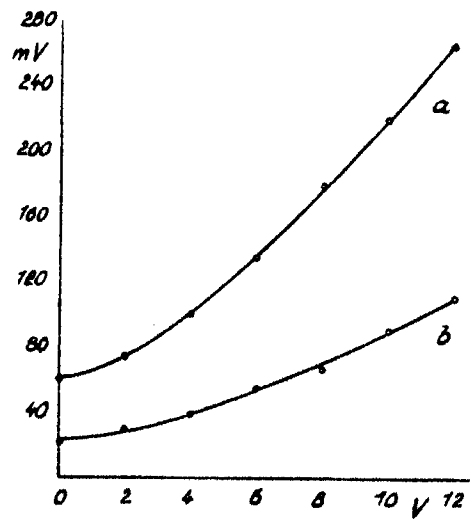


FIG. 1.

photo-electric effect (Dember effect). A. and A. Joffé have already suggested[1] asymmetry of the photo-electric current due to the illumination of one electrode.

In our investigations, two electrodes, free from any obstructing layer, were attached to a cuprite crystal so that by the illumination an E.M.F. appears on them in consequence of the Dember effect. These electrodes were connected through two condensers with an alternating current source; the current flowing through the crystal caused an additional direct voltage as soon as the crystal was illuminated. In darkness, however, the alternating current did not cause any direct voltage. By exchanging the direction of the light both the Dember effect and the direct voltage, caused by the alternating current, changed their direction.

In Fig. 1, the resulting voltage, measured with an electrometer, is shown in relation to the alternating voltage applied to the crystal. In curve *b* the intensity of illumination was a quarter of that of curve *a*. Hence the intensity of the new appearance is related to that of the Dember effect. The value of direct voltage at the alternating voltage zero corresponds to the crystal photo-effect.

Several trials have proved that this appearance is caused by events in the bulk of the crystal (bulk-rectification) and not by the obstructing layers between the planes of the crystal and the electrodes. Moreover, rectifying action, caused by exposure to light, could not be formed in synthetic cuprous oxide, in which the Dember effect does not appear.

GERHART GROETZINGER.
JOSEF LICHTSCHEIN.
Third Physical Institute,
University,
Vienna.
May 14

[1] *Z. Phys.*, **82**, 754 (1933).

## A Protective Action of Progesterone on the Genital Organs of Male Mice

It is recognized that œstrone and progesterone are mutually antagonistic in some of their biological capacities. A fresh example of this antagonism has recently been observed at this Institute. Sixteen male mice, eight of which had been previously castrated, were given œstrone twice a week by cutaneous applications of a 0·01 per cent solution in benzene. On every day following these applications, progesterone was given to some by subcutaneous injections of 0·1 c.c. of a 0·1 per cent solution in sesame oil, to others by the application to the skin of a 0·1 per cent solution in benzene. The mice died or were killed at intervals from the 28th to the 120th day of the experiment.

After death, all the castrated mice showed the usual effects of œstrone, namely, keratinization of the coagulation gland, with arrest of secretion and epithelial hyperplasia in the seminal vesicle and prostate. The eight non-castrated mice, with one exception, showed none of these characteristic effects of œstrone. Spermatogenesis was in progress, the coagulation gland, seminal vesicle and prostate were normal in appearance, and in two instances normal ejaculation plugs were observed at death. In the exceptional case the mouse, which had been treated by cutaneous applications of progesterone, was killed on the 73rd day, and showed defective spermatogenesis, keratinization of the coagulation gland and loss of secretory function with epithelial hyperplasia in the seminal vesicle and prostate.

The difference between the results in the castrated and the non-castrated mice may perhaps be attributable to a combined effect in the latter of progesterone plus the testicular hormone. However this may be, it seems clear that progesterone can protect the genital organs of non-castrated mice from the injurious effects of excessive dosage with œstrone. In this connexion the similarity of molecular structure between progesterone and testosterone will be recalled.

For the progesterone used in this experiment we have to thank Prof. Schoeller of the Schering-Kahlbaum, A.G. of Berlin.

HAROLD BURROWS.
Research Institute,
The Royal Cancer Hospital (Free),
London.
July 3.

## Determination and Excretion of Flavins in Normal Human Urine

KOSCHARA[1] has demonstrated the presence of flavins in urine, and has been able to isolate a crystalline flavin (uroflavin). I have carried out an investigation to determine if large doses of flavins (ox liver), similar to vitamin C (Harris[2] and van Eekelen[3]) and $B_1$ (Harris[4]), caused an increased urinary output.

The quantitative determination of the flavins in urine was carried out in the following way (details will be published elsewhere):

(1) Adsorption with lead sulphide. The lead sulphide was previously prepared, washed out and added to the urine. This was found to be preferable to the method generally used (addition of lead acetate to the flavin solution and introduction of hydrogen sulphide).

(2) Elution with a mixture of water-pyridine-glacial acetic acid (8 : 2 : 0·2).

(3) Oxidation with potassium permanganate in acetic acid solution and determination of the resulting colour with the stuphometer (*S* 47).

In normal urines (males), a daily urinary output of 819–1250 γ was found. The excretion per hour during the different periods of a day was found to vary between 30 γ and 50 γ.

Two subjects *A* and *B* (analysts) consumed cooked ox liver (100–140 gm.). Subject *A* took 5710 γ flavin[5] and excreted during 24 hours after the intake 3283 γ (normal excretion 952 γ), whereas subject *B* took 4240 γ and excreted 1797 γ (normal excretion 865 γ). The largest excretion per hour was observed two to three hours after the intake of the liver (subject *A*, 378 γ; subject *B*, 139 γ).

From these investigations, which took place in June, it follows that an increased excretion of flavins in urine took place after consumption of liver, probably caused by a 'saturation' of the subjects with flavins.

Further investigations are in progress.

A. EMMERIE.
Laboratory of Hygiene,
University,
Utrecht.
June 22.

[1] *Z. physiol. Chem.*, **[illegible]**, 101 (1935).
[2] *Biochem. J.*, **27**, 2011 (1933).
[3] Dissertation, Utrecht (1936).
[4] *Lancet* (1936).
[5] *Acta Brev. Neerl.*, **5** (1935).

## Ultracentrifugal and Electrophoretic Studies on Antibodies

MANY attempts have been made to obtain from immune sera, substances carrying the antibody function. Protein solutions specifically precipitable to the extent of 40–60 per cent (nitrogen precipitated by pneumococcus specific polysaccharide/total nitrogen) have thus been prepared by the Felton method[1]. By dissociation of specific precipitates with strong sodium chloride, antibody solutions precipitable to the extent of 90 per cent have been prepared[2]. An investigation of the physico-chemical properties of these systems, especially of those bearing upon chemical homogeneity and the relation to the components of normal sera, would seem to be of interest.

To this end, preparations of horse and rabbit antibodies against pneumococcus type specific polysaccharides, as well as rabbit antibody against crystallized egg albumin, have been studied by ultra-centrifuge and electrophoresis methods[3,4], together with whole and fractionated normal sera. The simplest behaviour was shown by a horse serum preparation of type I pneumococcus anticarbohydrate[5] in which 61 per cent of the nitrogen was specifically precipitable. This showed almost homogeneous sedimentation, with sedimentation constant $s_{20} = 17 \cdot 2 \times 10^{-13}$ as compared with that of normal globulin from mammalian sera, $s_{20}$ about $7 \times 10^{-13}$, previously found at Uppsala. However, normal sera regularly contain small amounts of a minor component of sedimentation constant about $17 \times 10^{-13}$. The electrophoresis of the above antibody preparation was homogeneous, with an isoelectric point as acid as *p*H 4·8.

In the case of rabbit sera, homogeneous sedimentation was found with no appreciable difference between the sedimentation constants of the globulin fractions of normal serum and immune serum, or of normal globulin and immune globulin containing up to 50 per cent of anti-egg albumin, or of antibody to the type III pneumococcus polysaccharide containing 90 per cent of precipitin[2], all showing $s_{20}$ about $7 \times 10^{-13}$. Only the last mentioned preparation was investigated electrophoretically, giving inhomogeneous migration and an isoelectric point of about *p*H 6·6.

Preparations from antipneumococcus I horse sera (Felton) showed the same principal component as did the horse antibody above, together with varying amounts of slower and faster sedimenting components; whereas a Felton solution from *normal* horse serum was quite different, with a predominating component of $s_{20} = 7 \cdot 8 \times 10^{-13}$. Electrophoresis was rather inhomogeneous, with isoelectric points of about *p*H 5–5·2 for the immune and *p*H 5·7 for the normal preparations.

In a few runs with horse antibodies, the centrifuge was stopped when all of the heavier components had settled to the bottom, although a considerable amount of the lighter substances were still in solution. Samples taken out indicated that almost all specifically precipitable protein was on the bottom, showing that the antibody function is connected with the heavy component. This is also in accordance with previous experiments[5,6].

Preparations made from antipneumococcus horse sera, preserved with phenol and ether, although containing up to 87 per cent specifically precipitable nitrogen, were characterized by their inhomogeneity both in the ultracentrifuge and in their electrophoretic behaviour. The isoelectric point was *p*H 5·9, but a component of an isoelectric point of about *p*H 4·9 was also present.

From these data it is evident that protein preparations from immune sera carrying a high percentage of the antibody function may show all the signs of being chemical individuals, so far as the methods referred to are decisive. Nevertheless, methods of preparation and preservation may considerably influence the result (by denaturation ?) and give rise to less uniform systems, which, however, may still show a very high specific precipitability. It is also clear that different fractions of the serum proteins carry the antibody function in the horse and in the rabbit. It would thus appear that the rabbit produces antibody from the principal globulin component, while the horse develops pneumococcus I anticarbohydrate, at least, from an otherwise minor component.

The analytical methods for determining the antibody content of the solutions have been described in earlier publications[7]. Details of the experiments will be given and some of the many questions raised by this work will be discussed in forthcoming communications.

MICHAEL HEIDELBERGER.
(John Simon Guggenheim Memorial Fellow, Spring of 1936.)
KAI O. PEDERSEN.
ARNE TISELIUS.

Institute of Physical Chemistry,
University,
Uppsala.
Presbyterian Hospital,
New York.
June 22.

[1] L. D. Felton, *J. Immunology*, **21**, 357 (1931), and other papers.

[2] M. Heidelberger and F. E. Kendall, *J. Exp. Med.* (Aug. 1936).

[3] See for example, T. Svedberg, *Chem. Rev.*, **14**, 1 (1934); *Kolloid Z.*, **67**, 2 (1934).

[4] A. Tiselius, *Nova Acta Reg. Soc. Scient. Upsaliensis*, Ser. IV, **7**, No. 4. See also Pedersen, K.O., *Kolloid Z.*, **63**, 268 (1933).

[5] M. Heidelberger and F. E. Kendall, *J. Exp. Med.*, **61**, 559 (1935); p. 570.

[6] W. J. Elford, P. Grabar and W. Fischer, *Biochem. J.*, **30**, 92 (1936). As this goes to press we note also very similar sedimentation constants obtained by J. Biscoe, F. Herčik and R. W. G. Wyckoff, *Science*, June 19, 1936.

[7] M. Heidelberger and F. E. Kendall, *J. Exp. Med.*, **50**, 809 (1929); and subsequent papers.

## Two Unusual Modifications of Eye Colour in *Drosophila melanogaster*

IN the course of a series of investigations now in progress concerning the modification of eye colour in the fruit fly *Drosophila melanogaster* under X-irradiation, undertaken in connexion with an attempted determination of the volume of the locus 'white', two changes of colour have been observed which seem of sufficient interest to be worthy of a note at the present time.

The first change involves an apparent reverse genovariation, under X-irradiation, similar to those observed by Timofeef-Ressovsky[1], the change being from white to red eye.

The white stock concerned was obtained by suitable breeding from a few white individuals arising as spontaneous mutants in a pure culture of Florida wild-type *Drosophila* obtained about two years ago through the courtesy of Dr. Demerec. It has been bred for three months in this laboratory in pure

culture, and has behaved in every way like typical white. It is, characteristically, completely recessive.

In the course of an investigation of morphological effects arising under X-irradiation, eggs and young larvæ from this white stock were exposed in considerable numbers to the unfiltered radiation of a Coolidge X-ray tube operated at 85 kvp. and 10 ma., the focal distance being five inches, with a wood backing. The tube was of lead glass with a thin sodium-glass window. The output of the tube was determined as 79·0 r./min. at the point of exposure of the material, a Victoreen dosimeter being employed. We are indebted to Dr. J. C. Hudson, of Cruft Laboratory, for this dosage measurement.

A total of 786 flies was examined from irradiated eggs and young larvæ. Among these were found two full reversions to Florida wild-type. It is believed that sufficiently elaborate precautions were observed in the technique adopted for irradiating and culturing the flies, so that the possibility of contamination from wild-type individuals was eliminated with reasonable certainty. No such reversions were observed in more than five thousand control individuals.

The second modification of interest arose in the stock of a culture of eosin *Drosophila* obtained from Turtox Service. Among more than 30,000 individuals examined, four were found in which a mutation to a colour considerably darker than eosin, but lighter than wild-type, was observed. We do not feel competent to name the colour modification. A single individual of the four constituted a mosaic representing a change which must have occurred very early in the development of the optic *anlage*, one eye of the fly being completely modified to the darker colour, the other typically eosin. Three of these individuals occurred in stock which had been irradiated under the same conditions as those stated above, but one was obtained from control populations grown on very old and highly infected molasses – corn meal agar medium. A very similar modification was independently observed by Dr. A. G. Richards, of the University of Rochester, and one of us, in control stock of a pure culture of eosin, obtained through the courtesy of Dr. Pincus, of Harvard University, and similarly held over old, depleted and infected banana – agar medium.

The modification seems of considerable interest in its further confirmation, not only that changes of whole eye colour may proceed from lighter to darker shades, but also that the wild-type condition is not necessarily the end-point of such a change. Again, sufficient care was used in handling the cultures, it is believed, to have eliminated the possibility of any contamination from an outside source with reasonable certainty. The change, indeed, was detected independently in three laboratories, at Rochester, Cambridge and Schenectady, and in none of these were stocks of similar eye colour present.

E. V. ENZMANN.
C. P. HASKINS.

Biological Laboratories,
Harvard University,
Cambridge, Massachusetts,
and the
Haskins Laboratory,
Schenectady, New York.
June 1.

[1] Timoféef-Ressovsky, N.W., *Nachrichten von Ges. d. Wiss. Göttingen*, N.F., 1, 190.

## The 'Road Runner' of North America

ONE of the most remarkable and interesting birds of the arid portions of North America is the road runner (*Geococcyx californianus*), a ground cuckoo, which is often seen running in the road, sharing this habit with the killdeer plover (*Oxyechus vociferus*). The genus extends southward to Nicaragua, being represented in that region by another species (*Geococcyx affinis*). The accompanying illustration

FIG. 1.

(Fig. 1) of a road runner attacking a rattlesnake, was furnished by Mr. G. A. Pearl of Garden City, Kansas. He got it from a travelling photographer whose name he does not know. Mrs. Merriam Bailey states that in the stomach of a single road runner, taken in New Mexico, were a large black cricket, a number of big grasshoppers, remains of a caterpillar and some beetles, a centipede six inches long and a garter snake a foot long.

The road runner was described by Lesson in 1829, but Pike in 1810 refers to a strange new bird, which from his vague account must apparently have been the road runner.

T. D. A. COCKERELL.

University of Colorado,
Boulder, U.S.A.

## Ascent of Air in Cyclones

A RECENTLY completed investigation on cyclones has led, amongst other results, to one which throws an interesting light on a long-standing problem. One of the deductions of W. H. Dines from soundings of the upper air was that the air in the troposphere in depressions, particularly between 4 km. and 9 km., is on the average cold for its level, though this air is, on the whole, ascending. The paradox is to explain by what agency the ascent of relatively cold air is maintained. Dines's results related to depressions crossing the British Isles or Western Europe, that is, to depressions which as a rule were in the later stages of their existence.

The present investigation shows that in a number of such depressions the structure comprises an outer region in which the average air speed varies inversely as $r$ ($r$ being distance from isobaric centre), and an inner region (at least in the polar air part) in which air speed varies directly as $r$. The existence of the outer simple vortex region is consistent with motion developed by convergence towards a central area:

the mathematical theory of the motion developed in this way was given by Rayleigh[1] in 1917, in explanation of the model cyclones devised by Aitken[2]; the mathematical theory was extended by Brunt[3] in 1921 to apply to motion on a rotating earth.

The inner regions generally are found not to be examples of 'solid spin', at least in the lowest 2 km. of the atmosphere, but rather, in certain parts, regions of specially marked convergence. In brief, it is found that—below the 2 km. level—convergence towards the centre goes on, roughly with complete conservation of moment of momentum up to a certain distance (which in different cases varies from 300 km. to 500 km.) from the centre, and then—in place of conservation—there is, instead, as the air enters the inner region, a gradual fall of speed with closer approach to the centre.

The total inward flux of kinetic energy across the periphery of the inner region is so considerable—speeds at this periphery being commonly of the order of 40 m.p.h.—that a question naturally arises as to what work is being done to account for the loss of kinetic energy by the air in the course of its closer approach to the centre. The obvious explanation is that here is the work required in the later stages of the depression's life to raise bodily the large central core of troposphere which, by reason of continued ascent, has become colder, level for level, than its environment. Calculation in a typical case indicates that about half the probable inward flux of kinetic energy below the 2 km. level would suffice to keep the core above this level moving upward until it had become on the average about 7° C. colder, level for level, than surrounding regions. This result, therefore, explains the manner in which depressions can continue in being until they acquire temperature characteristics which have hitherto seemed paradoxical, more especially in regard to any theory of origin in which convection may have played a part.

In one exceptional case—a vigorous and still developing system with a long course still to run—the feature characteristic of the inner regions of the other depressions was not developed, at least at the time when the depression crossed the British Isles. In this depression by contrast, a high wind speed was found up to relatively near the centre.

A. H. R. GOLDIE.

Meteorological Office,
Edinburgh.

[1] *Proc. Roy. Soc., Lond.*, A, 93, 148 (1917).
[2] *Trans. Roy. Soc., Edin.*, 40 (1900–01); *Proc. Roy. Soc., Edin.*, 36 (1915); and *Proc. Roy. Soc., Lond.*, 94 (1917–18).
[3] *Proc. Roy. Soc., Lond.*, A, 99, 397 (1921).

## Transmission of High-Voltage Impulses at Controllable Speed

SIR J. J. THOMSON[1] first observed that if a difference of potential was applied to the ends of a long discharge tube (by an induction coil) the luminosity traversed the tube with a finite velocity. When either a positive or negative impulsive potential is suddenly applied to one end of a discharge tube while the other end is maintained at ground potential, one of us[2] found that the luminosity traversed the tube from the high-voltage electrode to ground. Immediately following this, a luminosity frequently traversed the tube from the ground back to the high-voltage electrode. A similar type of propagation of luminosity has been observed in a million volt spark between point and plane by Allibone and Schonland[3] and by Schonland and others[4] for certain types of lightning flashes. In order to obtain more information about the initial breakdown in gases, we have undertaken an investigation of the propagation of potential in long discharge tubes when impulsive voltages are applied to one end of the tube while the other end is earthed.

By means of a high-speed cathode ray oscillograph, it was found that in the case of both positive and negative applied impulses, a definite potential wave traversed the tube from the high-voltage electrode to the earthed electrode, immediately followed by a much faster return wave from ground back to the high-voltage electrode. In the case of the initial impulse, the wave velocity, wave form, voltage attenuation and energy carried in the wave front were measured and found to vary with both pressure and applied potential. A few values for the speed of the initial impulse in a 5 mm. glass tube containing air are shown in the accompanying table.

| Applied Voltage (kv.) | Pressure (mm. Hg.) | Speed of Impulse (cm./sec.) |
|---|---|---|
| +127 | 0·08 | $9 \times 10^8$ |
| +127 | 0·24 | $43 \times 10^8$ |
| −125 | 0·03 | $15 \times 10^8$ |
| +171 | 0·17 | $27 \times 10^8$ |
| + 74 | 0·017 | $5{\cdot}4 \times 10^8$ |
| + 74 | 0·24 | $14 \times 10^8$ |

For the greater applied potentials the voltage wave showed no observable distortion or attenuation, at least for lengths of tube less than 10 metres. However, at 74 kv. and the higher pressure (0·24 mm.), the voltage wave was very much flattened. For the 170 kv. and 74 kv. applied impulses with 0·025 mm. pressure in the tube, the maximum current during the initial wave was 429 amp. and 146 amp. respectively. In addition to the information the above results give as to the nature of the initial breakdown in gases, they show that a discharge tube may be used as a transmission line in which the velocity of propagation of the voltage wave is easily controllable over quite wide ranges. This type of transmission line should be of use in many problems[5] where it is necessary to transmit high-voltage impulses from point to point at predetermined velocities less than that of light.

The detailed results of this experiment will be submitted for publication elsewhere. We wish gratefully to acknowledge a grant from the American Philosophical Society, which has made this work possible.

L. B. SNODDY.
J. W. BEAMS.
W. T. HAM, JUN.
H. TROTTER, JUN.

Rouss Physical Laboratory,
University of Virginia.
June 20.

[1] "Recent Researches", 115 (1893).
[2] Beams, *Phys. Rev.*, 36, 997 (1930).
[3] Allibone and Schonland, NATURE, 134, 736 (1934).
[4] Schonland, Malan and Collins, *Proc. Roy. Soc.*, A, 152, 595 (1935).
[5] Beams and Snoddy, *Phys. Rev.*, 44, 784 (1933).

## Narrow Continuous Band of Potassium in the Extreme Red

ALTHOUGH the absorption bands which appeared, as reported by Kuhn[1] and Datta[2], near the principal series lines of potassium at high vapour pressures were interpreted on the assumption of polarisation of the molecule, the bands which may have appeared near the resonance lines λλ7699, 7665 were not observed.


FIG. 1.


FIG. 2.

With the view of searching for these bands, the extreme red absorption spectrum of potassium vapour was investigated. By heating the potassium metal in a steel tube filled with hydrogen to a pressure of about 10 cm. mercury, spectral photographs of the potassium vapour were taken at the first order region of the 1·5 m. concave grating. When the continuous light from a carbon arc passed through the vapour, keeping the temperature sufficiently high, a remarkable broadening of the resonance lines, as shown in Fig. 1, was observed. At higher temperatures a narrow continuous band appeared at about λ7220 (Fig. 2), while Fig. 3 shows its photometer curve. In the absence of hydrogen this band was also observed, but with difficulty.

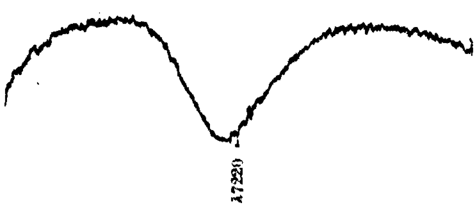


FIG. 3.

Wurm[3] reported a narrow band of sodium appearing on the shorter wave-length side of the $D$-lines, explaining it by assuming polarization of the molecule. Hamada[4] observed the fluctuation of a continuous band in the same region, considering its origin as the sodium quasi-molecule. The potassium λ7220 band may be interpreted in the same manner.

Though the longer wave-length side of the potassium resonance lines was also photographed, the absorption of the $A^1\Sigma \rightarrow B^1\Sigma$ band was so strong that any narrow continuous band was difficult to observe.

T. OKUDA.


Department of Physics,
Osaka Imperial University,
Japan. May 12.


[1] H. Kuhn, *Z. Phys.*, **76**, 782 (1932).
[2] S. Datta and B. H. Chakrovarty, *Ind. J. Phys.*, **7**, 273 (1932).
[3] W. Wurm, *Z. Phys.*, **79**, 736 (1932).
[4] H. Hamada, *Phil. Mag.*, **15**, 574 (1933).

## Liquids of High Refractive Index

IN a previous letter to NATURE[1] under this title, we gave values for the refractive index of phenyldi-iodoarsine as measured by us. Our attention has now been directed to the fact that the properties of this compound had already been accurately measured and published in a valuable paper on "The Optical Properties of Arsenic" by Gryszkiewitz-Trochimowski and Sikorski[2] which had appeared six years previously. We had unfortunately overlooked this paper owing to the fact that in none of the abstracts or collective indexes which we consulted as a guide to the relevant literature was there any mention of the above compound in connexion with these authors. The figures for phenyldi-iodoarsine given by the Polish workers ($n_D^{14\cdot5}$ 1·8527 ; $d_4^{14\cdot5}$ 2·6264) are higher than those we communicated, but agree closely with those we have recently obtained with the purer samples now commercially available.

We take this opportunity to add a warning note. Though we occasionally use phenyldi-iodoarsine when refractometer readings of high index are required, the action of this liquid on the soft glass hemisphere of the instrument is distinctly deleterious. The chief usefulness of this remarkable compound will thus probably be as an immersion medium.

B. W. ANDERSON.

C. J. PAYNE.


Laboratory of the Diamond,
Pearl and Precious Stone
Trade Section of the London
Chamber of Commerce,
55 Hatton Garden, E.C.1.


[1] NATURE, **138**, 66 (1934).
[2] Gryszkiewitz-Trochimowski and Sikorski, *Roczniki Chemji*, **8**, 405 (1928).

## Structure of Bromine III

IN a previous letter[1] it was reported that the structure of Br III was detected, the intervals of the fundamental term $5s$ $^4P$ being 2589 cm.$^{-1}$ and 2253 cm.$^{-1}$. A further comprehensive investigation, carried out particularly to distinguish between the lines of Br II and Br III, has led to a considerable extension of the scheme, which consists of doublets and quartets of the $4p$, $5p$, $5s$, $4d$ and $5d$ configurations. On account of the large intervals of the $4d$ and $5d$ configurations, it is difficult to assign the $L$-values to these terms. Assuming an arbitrary value of 300,000 cm.$^{-1}$ for $4p$ $^4S_{1\frac{1}{2}}$, some of the chief term values are :

| | | | |
|---|---|---|---|
| $5p$ $^4D_{\frac{1}{2}}$ | 126823 | $5p$ $^4P_{1\frac{1}{2}}$ | 121875 |
| $5p$ $^4D_{1\frac{1}{2}}$ | 126165 | $5p$ $^4P_{2\frac{1}{2}}$ | 119751 |
| $5p$ $^4D_{2\frac{1}{2}}$ | 124095 | $5s$ $^4P_{\frac{1}{2}}$ | 154588 |
| $5p$ $^4P_{\frac{1}{2}}$ | 123835 | | |

The intervals of $4p$ $^2D$ and $^2P$ are found to be 1259 cm.$^{-1}$. and 1665 cm.$^{-1}$ respectively. About 200 lines of Br III have been classified altogether.

The complete analysis is being communicated to the Royal Society of London.

K. R. RAO.


Andhra University,
Waltair.
May 27.


[1] NATURE, **135**, 309 (1935).

### Preparation of Lithium Alum

DURING some work on the mass susceptibility of the alums, a successful attempt was made to prepare lithium alum, despite the fact that its existence and even the probability of its existence has been repeatedly denied.

Molecular proportions of the monohydrate of lithium sulphate and the octadecahydrate of aluminium sulphate were dissolved in the minimum quantity of cold water. The solution was concentrated considerably by evaporation on a sand bath and cooled in a freezing mixture of ice and salt with vigorous stirring, when it crystallized suddenly and deposited a mass of very soft small crystals, which were filtered and dried at the pump and afterwards on porous plates. The mother liquor after a further slight concentration deposited small hard transparent crystals on keeping in the freezing mixture.

Both crops of crystal contain 49·00 per cent of water ($Li_2SO_4Al_2(SO_4)_3.24H_2O$ requires 48·93 per cent water). The crystals are isotropic, a combination of cube and octahedron. On keeping at ordinary temperature, or on warming a few degrees, they decompose and the salts dissolve in the liberated water. They are exceedingly soluble in water; they lose the whole of the water at 200° C. and swell to a bulky friable mass. The mass susceptibility is $-0{\cdot}541 \times 10^{-6}$ and molecular susceptibility $-479 \times 10^{-6}$. The properties of the alum are under investigation.

JAMES F. SPENCER.
G. T. ODDIE.
(Sister Mary Cecilia, O.P.)

Bedford College,
London, N.W.1.
July 3.

## Points from Foregoing Letters

DR. A. S. RUSSELL describes work which suggests that metals of the class which forms compounds with metals of the copper, iron, cobalt and nickel class may be arranged in a list analogous to the electrochemical series. Any metal in this list can displace from intermetallic combination one lower in the list.

The formation of long carbon dendrites has been observed by K. D. Luke and Drs. W. M. Madgin and H. L. Riley in the cathodic reduction of colloidal solutions of graphitic oxide. Colloidal particles of graphitic oxide are negatively charged, and the reduction occurs in spite of the strong repulsive forces which must exist in the neighbourhood of the cathode.

The large majority of the negative ions formed during electric discharge in mercury vapour, hydrogen, nitrogen and carbon dioxide, Dr. F. L. Arnot finds, do not arise by the attachment of one electron to a neutral atom, but by the attachment of two electrons to a positively charged ion. The author calculates the probability of such conversion from positive into negative ions, for the gases mentioned above, at the surface of a negatively charged nickel electrode.

From the energy of the neutrons selectively captured by rhodium, Drs. P. Preiswerk and H. von Halban, jun., deduce the distance, breadth and form of the nuclear levels in that element. The data required were obtained by determining the absorption coefficient for each additional layer of rhodium.

Light falling upon a cuprite crystal in contact with two electrodes through which an alternating current is passing, produces an additional direct voltage. Dr. G. Groetzinger and J. Lichtschein submit curves showing how the resulting direct voltage varies with the alternating current, and its relation to the crystal photo-electric effect. They consider that this additional current is connected with events taking place in the interior of the crystal.

Experiments on mice carried out by H. Burrows indicate that progesterone, a substance related to the male sex-hormone testosterone, can protect the genital organs of the non-castrated animals from the injurious effects of large doses of the female sex-hormone, oestrone.

An increased excretion of the yellow pigments, flavins, in the urine, after eating cooked ox-liver, is reported by A. Emmerie.

From the rate of sedimentation and the movement in an electric field (electrophoresis) of the protein particles from horse serum carrying an anti-body, Prof. M. Heidelberger, Kai O. Pedersen and Arne Tiselius conclude that the particles are of uniform size and possibly a definite chemical compound. The sedimentation constant is $17{\cdot}2 \times 10^{-13}$, and the anti-body is apparently formed from a heavier minor component of the protein. The rabbit anti-body against crystalline egg-albumin, on the other hand, is produced from the principal globulin component.

Two unusual modifications of eye colour in the fruit fly, under X-ray irradiation, are reported by Dr. E. V. Enzmann and C. P. Haskins. In one case the change was from white to red, involving apparently a reverse genovariation; in the second case mutations in a culture of eosin *Drosophila* produced eye colour considerably darker than eosin, showing that wild-type condition is not necessarily the end-point of change from light to darker shades.

In the centre of a 'depression', in the later stages of its existence, the air at a height of 4–9 km., though colder and therefore heavier than surrounding layers, is nevertheless ascending. The energy needed to lift it, Dr. A. H. R. Goldie suggests, is provided by the winds, which give up part of their energy and slow down as they converge spirally towards the centre of the depression.

The propagation of voltage impulses in long discharge tubes has been investigated by Dr. L. B. Snoddy, Prof. J. W. Beams, W. T. Ham, jun., and H. Trotter, jun. The tube was found to be an excellent transmission line for high-voltage impulses. The velocity of propagation was easily controllable over quite wide ranges of the order of $10^8$–$10^9$ cm. per sec.

A broadening of the resonance lines in the extreme red of the absorption spectrum of potassium vapour in the presence of hydrogen gas is described by T. Okuda, who considers it due to the polarization of the molecules.

ERRATUM. Dr. C. H. Douglas Clark, referring to the paragraph in this column (July 18) on his letter "Optical Polarization Ellipsoids of the Hydrogen Halide Gases", states that it is the polarizability along the long axis which is equal to that of the corresponding negative ion.

# Research Items

### Pre-Crag Flint Implements

THE evidence bearing on the age of the implements of flint which since 1909 have been found in the Suffolk bone bed has been reviewed by Mr. J. Reid Moir in the light of the conclusions to be drawn from patination, from forms and flaking, and from condition (*J. Roy. Anthrop. Inst.*, 65, Pt. 2; 1935). It is argued that just as in a Pleistocene deposit implements can be sorted out according to their types and assigned to their appropriate age, so in a Pliocene deposit it is legitimate to treat them in a corresponding way. By observing the differences in patination and the reflaking of the pre-Crag flints, it is possible to divide them into five groups; and this classification is supported by an examination of form. Group 1, for example, is rich in implements of the Harrisonian eolithic type, made chiefly from primitive and coarsely shaped implements; but being made from primitive flake implements, they show an advance in technique on the true Harrisonian eolith, which was made from pieces of naturally broken tabular flint. In all the other groups, implements of this type are rare, showing that the production of artefacts of eolithic character ceased after the epoch in which implements of Group 1 were made. Of the rostro-carinates, the same proportion is present in Groups 1, 2, 3, but in 4 the proportion is much less, while in Group 5 none appears. In Group 2, where rostro-carinates occur in the same proportion as Group 1, the eolithic form, which is rare, is replaced by a whole series of racloirs, points, scrapers, choppers and other types. Group 5 is remarkable in being composed of 50 per cent racloirs and 50 per cent unclassifiable specimens. In the 363 specimens, only eight hand-axes are present, though the presence of one specimen in Group 1 shows that the knowledge how to make the hand-axe goes back a very long way. Taking the evidence as a whole, it is maintained that there are few who would deny that Group 1 is of very great antiquity but cannot represent the first attempt of man to shape flints; while Groups 2, 3 and possibly 5 are the most advanced. Group 4 seems to show a slight but very definite regression.

### Fishes from the *Pawnee* Second Oceanographic Expedition

FOLLOWING his first and second reports (1928 *a* and *b*) in the same publication, Mr. C. M. Breder, jun., deals with the Heterosomata to Pediculati from Panama to Lower California (Scientific Results of the Second Oceanographic Expedition of the "Pawnee" 1926. *Bull. Bingham Oceanographic Coll.* Peabody Museum of Natural History, Yale University, 2, 1936). There is much interesting matter in this report, which includes many new species and observations. The new genus *Hubbsiella* is created to include *Menidia clara* Evermann and Jenkins, which differs from *Menidia* proper in several important characters, as has already been noticed by Jordan and Hubbs. Remarks on *Alectis hopkinsi* (Jordan and Starks) suggest that the Pacific representatives may lose their juvenile filaments of the dorsal fin normally by breakage, the stubs simply healing up and not regenerating. A useful key to the Eastern Pacific Hæmulidæ is given, containing twelve species belonging to nine genera.

### Land and Freshwater Molluscs of Colorado

PROF. JUNIUS HENDERSON has enlarged greatly and corrected his original report of 1924 on this subject, and the present monograph, "Mollusca of Colorado, Utah, Montana, Idaho, and Wyoming—Supplement" (*Univ. Colorado Studies*, Vol. 23, No. 2, 1936), includes much new material. Careful work has been done upon Rocky Mountain molluscs during the past decade, resulting in a better understanding of many species and the addition of a number to the fauna, some of them new to science. In the comprehensive work now before us, we find a very large number of both land and freshwater forms listed and criticized, with valuable notes and, in some cases, figures and plates. All workers on mollusca in these districts will benefit by the publication of this most useful paper.

### Animal Products

CHAPTERS vii and viii of the second part of the first volume of "Die Rohstoffe des Tierreichs" (Berlin: Gebrüder Borntraeger, 1935. 21.50 gold marks) deal with the hard substances produced by animals, ranging from fish scales, otoliths, tortoise shell and bird's claws to rhinoceros horns, antlers, bone and ivory. The second chapter treats of glue, gelatine and slime. Each product is considered historically, and its characteristics and treatment given. The data concerning its trade and the uses to which it is put are discussed. The full bibliography at the end of each chapter is subdivided into sections for each product. It is a most useful source of information.

### Pathogenic Actinomyces

"THE Pathogenic Aerobic Organisms of the Actinomyces Group" is the title of a report by Dagny Erikson (Medical Research Council. Special Rep. Series, No. 203. London: H.M. Stationery Office. 1*s*. net). The study of fungi of medical importance has been hindered in the past by inadequate examination and description and by confused nomenclature. In this report, Miss Erikson has examined a number of strains of *Actinomyces* collected by Dr. A. G. Gibson from enlarged spleens in various clinical conditions, and a series of strains—variously labelled *Actinomyces*, *Streptothrix*, *Nocardia*, etc.—contained in the National Collection of Type Cultures, maintained by the Medical Research Council at the Lister Institute, London. The cultural, morphological and biochemical characters of twenty-five species are described, including fifteen that appear to be entirely new forms.

### Testing Green Karri Timber

UNDER the auspices of the Council for Scientific and Industrial Research of the Commonwealth of Australia, the Division of Forest Products is undertaking an extensive series of tests on the mechanical and physical properties of the timber of karri (*Eucalyptus diversicolor*). Several special tests have so far been carried out ("A Discussion of Special Tests on the Compressive Strength of Green Karri" by Ian Langlands, Division of Forest Products, Pamphlet No. 61—Tech. Paper, No. 19. Government Printer,

Melbourne, 1936). It is shown in this paper that green karri will withstand greater stresses perpendicular to the grain when the load is applied to the tangential face than when it is applied to the radial face. The modulus of elasticity of karri is also much higher when the load is applied to the tangential face. The influence of the width of the loading plate on the compressive strength perpendicular to the grain is considered in detail. The results are given of a series of tests on green karri which were carried out to check the applicability to this species of a rational formula suggested by the U.S. Forest Products Laboratory for northern hemisphere timber. The tests showed that the formula applies very closely when the stress at 1/10 in. deflection is considered; but if the stress at the limit of proportionality is taken as the criterion, the agreement is not so good because of unavoidable eccentricities in loading.

### The Japanese Earthquake of February 21, 1936

THOUGH it did not attain more than semi-destructive intensity, the Kawati-Yamato earthquake of February at 10h. 8m. (1h. 8m. a.m., G.M.T.) ranks as the strongest felt in central Japan since the Tango earthquake of 1927. It is described in three short papers published in vol. 14 of the *Bulletin* of the Earthquake Research Institute. Messrs. N. Nasu and T. Hagiwara (pp. 285–289) study the early after-shocks, of which there were 77 during the first 24 hours. A network of five seismological stations was formed around the epicentre near Mt. Hutagami, from the records at which it was found that the focal depths of five after-shocks during the first fortnight were less than six miles. Mr. N. Miyabe (pp. 297–306) remarks that earth-sounds were heard at many places, but they seemed to come as a rule from the nearest mountain rather than from the epicentre. Lights were noticed with the earthquake by several persons, but it is not certain that they were connected with it. Mr. T. Saita (pp. 307–317) examines the relation between the amount of damage and geological structure. He states that, on hard ground, heavy buildings collapsed seriously, while, on soft ground, old and poorly built houses were much damaged.

### A Piezoelectric Ultra-micrometer

THE ultra-micrometer is an instrument for the measurement of linear displacements smaller than those which can be measured by optical interferometry; these are limited by the wave-length of light. Whiddington in 1920, using two oscillating electrical circuits tuned so as to produce an audible beat tone, was able to extend the sensitivity of measurement to a value smaller than $10^{-8}$ cm. Later on, W. G. Cady and D. W. Dye used a piezo-electric quartz plate instead of a resonant electrical circuit. In *Science* of May 15, Prof. J. C. Hubbard describes how by using a quartz plate of 600 kilocycles resonant frequency, a frequency change of one sixtieth of a cycle may be detected. This corresponds to a frequency change of about three parts in one hundred million. To test the method, a micrometer condenser has been constructed so that each plate is attached to a separate support clamped to a heavy steel rod. Adjustments are provided for making the plates parallel and for making relatively large variations of plate distance by means of a micrometer screw. A variable condenser in parallel is provided so as to operate the micrometer condenser at any desired plate distance and thus secure a wide range of sensitivities. In the experiments which have hitherto been carried out, displacements of $10^{-8}$ cm. have been measured with an inaccuracy less than a few per cent, although no special precautions were taken against mechanical disturbances. It is hoped that by taking such precautions, displacements of $10^{-10}$ cm. may be measured. The attainment of a sensitivity of this order should open a new avenue of approach to many important and interesting problems in atomic and molecular physics.

### Bakelized Bearings

AN extraordinary development in the kind of bearings used in machinery intended for heavy service is described in the *Metropolitan-Vickers Gazette* of July. The provision and maintenance of bearings in rolling mills is more difficult probably than in any other industry. The pressures are high, the conditions are usually dirty, and maintenance and replacements are difficult and expensive, both in cost of spares and in time lost while repairing or changing. For the heaviest service, white metal bearings have been found quite inadequate. Bronze bearings, usually called brass, are commonly used, but the wear is very rapid. Much thought has been given to this problem, and after many attempts an apparently most unlikely solution has proved the best. It has been found that a bearing material consisting of a fibrous substance like paper or cloth bonded with 'bakelite', a synthetic resin, is far better for this service than any metal. Also, no oil is used, but the bearing is fed continuously with a stream of water. The water has a dual function; in the first place it acts as a lubricant, and in addition it fulfils a more important function by keeping the bearing cool. Cooling is specially required in bearings of this kind, owing to the fact that the heat conductivity of the bakelized bearing material is very much smaller than that of metal. A stream of water is found the best means to carry away the heat generated by friction. A very large number of these bearings are already in service and give good results. The saving in power varies from 30 to 60 per cent, the life is increased about ten times, and there is a saving in the workers' time, as there is seldom need to adjust the rolls.

### Relativistic Problem of Two Bodies

THE present verifications of the general theory of relativity deal only with gravitational fields due to a single body. For example, in the case of the advance of the perihelion of Mercury, the field is considered as due to the sun alone, an approximation which is legitimate owing to the smallness of the ratio of the mass of the planet to that of the sun. Prof. T. Levi-Civita (*L'Enseignement Mathématique*, **34**, 149; 1935. Paris: Gauthier-Villars), deals with the corresponding problems for two bodies of comparable mass. The equations of relative motion, to a certain degree of approximation, show that we may speak of a central force separable into a Newtonian attraction and an Einsteinian perturbation, which produces an advance of perihelion. This might have been expected, but it is strange to find that the centre of gravity oscillates slightly instead of being at rest or moving uniformly in a straight line. There seems no hope of testing this by observation, but the new formula for the advance of perihelion (slightly different from that applicable in the case of Mercury) may possibly be verified by observation of double stars.

# Museums Association

## ANNUAL CONFERENCE AT LEEDS

THE forty-seventh annual conference of the Museums Association was held at Leeds on July 6–10. The meetings were held in the Museum, and the usual trade exhibition and members' exhibits were in the entrance hall of the Art Gallery. The conference attracted a record attendance; more than three hundred members and delegates met under the presidency of Sir Eric Maclagan, director of the Victoria and Albert Museum.

Sir Eric, in his presidential address on "Museums and the Public", gave a summary of the various services afforded children and adults by the museums. He is not convinced that children's museums, as separate entities, are a wise ideal, and preferred that children's exhibits should constitute a bait rather than a permanent diet. He would like to see the abolition of many petty restrictions upon adults, such as the ban upon walking-sticks and umbrellas; yet, on the other hand, there is the danger of coddling the public owing to the excellent seats, gardens, refreshment rooms and guide lecturers now at the service of the visitor. Too little, perhaps, is being left to the public, and museums are not peep-shows and need not degenerate into them. In view of the little that museums do which has any real news value, Sir Eric thinks that great credit should be given to the newspapers, which are so often among the museum's best friends.

Following the presidential address, Col. Kitson Clark told the interesting story of the various Leeds museums and the persons responsible for their foundation. The morning session concluded with an address by Sir Harry Lindsay, director of the Imperial Institute, upon the various methods of visual instruction developed and used for adults and children in the Institute.

In the afternoon, Mr. F. R. Worts, headmaster of the City of Leeds School, dealt with museums and secondary schools, a subject which elicited a lively discussion, from which it was apparent that too much is expected from the museums and too little co-operation offered by the schools. The session concluded with a somewhat detailed, but important, discussion on nomenclature in natural history collections, opened by Dr. F. J. North, and a description of the new Perth Museum and Art Gallery by its director, Mr. J. Ritchie, who illustrated his remarks with lantern slides and a cinematograph film.

The opening paper on Wednesday morning was by Mr. Leigh Ashton, of the Victoria and Albert Museum, who described the display methods he used so successfully in arranging the recent Chinese Art Exhibition at Burlington House. He was followed by Mr. Philip Hendy, director of Leeds City Art Gallery, who had much to say about the lack of civic encouragement to art galleries. He deplored the lack of visual imagination at the present time and the tendency to "think in print". He regrets the decay of craftsmanship, and looks upon the art gallery as a remedy to industrialism, but he thinks that art galleries might profitably exhibit more manufactured objects. Mr. S. F. Markham followed with an account of the museums in India, based upon his recent survey, and the morning session concluded with an important discussion on the copyright of paintings in museums and art galleries.

Thursday morning was occupied largely by the annual general meeting but there was a vigorous discussion on the future of the Association. Finally Dr. Mortimer Wheeler read an account, by Mr. Iliffe of the folk museum movement in Palestine.

Excursions were made to various places of interest including Temple Newsam Mansion, Kirkstall Abbey, Harewood House and Fountains Abbey.

The new president of the Association is Alderman Charles Squire, of Leicester, and the next conference will be held at Newcastle-upon-Tyne.

# Society of Chemical Industry

## ANNUAL MEETING AT LIVERPOOL

THE programme of the annual meeting of the Society of Chemical Industry at Liverpool, July 6–10, in itself provides an excellent illustration of the way in which chemical industry is linked up with almost every aspect of our national life, and of the extent to which chemical science enters into questions not only of industry but also of transport, food supply and the like.

The Messel Memorial Lecture, "Works as I have seen them Grow", delivered by Sir Robert Mond on July 8, gave an impressive account of the development of the Winnington works of Brunner, Mond and Co., as well as of the Mond Nickel Co. and the Mond Gas Companies, which well illustrates the creative power of science in developing new industries or adapting old ones to changed conditions. It might also be regarded as a dissertation on the theme that the mental process of pure research, the way of asking Nature the right question and of obtaining adequate responses, is as applicable to applied as to pure science. Knowledge of progress depends on trustworthy and continuous measurements of all the many factors involved, and these measurements can be effected as well on a works as on a laboratory scale, and with intelligent designing no great or specially expensive methods are required. Acting on

this principle, Dr. Ludwig Mond not only made the Solvay ammonia-soda process a commercial and technical success, but also showed by what means the science of physical chemistry could be studied practically and developed in a works instead of in a laboratory.

Sir Robert Mond suggested that this was his father's great contribution to human progress, and those who took part in the numerous visits to works and factories during the week found much to justify Sir Robert's assertion. It was equally supported by papers presented to the meeting such as Dr. R. Houwink's address to the Plastics Group on "Synthetic Resins, their Formation, Properties and Possibilities", Dr. L. H. Lampitt's on "Food Package and the Consumer" at the Food Group Congress held jointly with the Royal Sanitary Institute at Southport, or Mr. R. G. Batson's address to the Road and Building Materials Group on "Scientific Research and the Highway Engineer".

All these papers and discussions emphasized the way in which exact measurements by physical methods are laying the foundations for future advance. Dr. Houwink, discussing future developments, said that one of the most urgent requirements is for stronger, more elastic, more shock resistant and electrically improved products, and referred to the possibility of improving the properties of shellac so that competition with resins like those of the phenol-formaldehyde type become possible again. Dr. Lampitt referred to the way in which growing public appreciation of the importance of hygiene has led to fresh demands for packing materials which the chemist has been able to meet.

The address for which the Liverpool meeting will be most remembered, however, is that of the president, Mr. W. A. S. Calder, on July 7, on "The Chemist as World Citizen". Mr. Calder linked up the chemist and his training to acquire and face facts with his wide responsibilities in the world to-day. One of the chief causes of the dangers to freedom and progress is the utter ignoring of facts, and Mr. Calder protested strongly that the chemist is not the destroyer which the irresponsible Press represents him to be. It is a lamentable fact, however, that we are all susceptible to the poisonous virus of newspaper propaganda. No one capable of thought can fail to admit that no one nation is ever entirely responsible for a war, and Mr. Calder pointed out that the training of a chemist should teach him the impossibility of being always right. Chemists cannot escape the responsibility of seeing that the danger of refusing to face facts is duly impressed upon our politicians.

Another direction in which the chemist can play a part as a world citizen is that of the prevention of accidents. The chemist and engineer are qualified by their training to be of special service in anticipating risks and thus preventing accidents. Many accidents still occur which could not be possible if those in charge of affairs fully realized their responsibility. Men are even exposed to unnecessary risks which they are expected to avoid by compliance with impossible orders for their own safety, and Mr. Calder expressed the hope that the interchange of details of accidents already taking place between several countries might become world-wide.

# Coral Reef Ecology at Low Isles

THIS fine contribution* to the series of reports on the Great Barrier Reef Expedition of 1928–29 is chiefly concerned with accounts of three traverses across the reefs at Low Isles. Its production is the result of a collaboration between several workers; Prof. T. A. Stephenson originally chose the traverses; physical and chemical data were provided by Mr. A. P. Orr, and level sections by Mr. M. A. Spender. The bulk of the work, however, fell to Dr. Fraser and Dr. S. M. Manton, who jointly enumerated the organisms present, while the latter is responsible for drawing up this report.

Along each traverse a strip of reef one yard in width was examined. The first traverse, more than 1,000 feet long, started from a Thalamita flat inside the reef and crossing a shallow moat, passed over a boulder tract to descend the seaward slope of the reef to the muddy sea-floor at about twenty feet below datum. The second traverse, about half the length of the first, crossed a portion of the reef where the contour of the sea-floor was rather irregular. The third traverse on the windward side of the reef could not be worked in detail on account of the roughness of the water; but such observations as were made are nevertheless of much interest.

The results of these surveys are given in a number of graphs that permit easy comparisons to be made of the distribution of corals and algæ, both as regards abundance of individuals and of species. Algæ were abundant only in the moat and on the inshore part of the second traverse; they were almost absent from the seaward slopes of all three. Coral growth was vigorous in the deeper part of the moat—where there is always nearly a foot of water at low tide—as well as on the seaward slopes of the traverses below the datum line. In the moat physical conditions were extreme, especially as regards temperature and to a considerable extent silting; the association of species living there was hence not the same as that outside. *Montipora ramosa* was the dominant coral in the moat, indeed being restricted to that situation, whereas the *Acroporas*, species sensitive to heat and silt, were almost entirely confined to the seaward slopes.

One of the more important points brought out is the influence of silt on the distribution of corals. It seems clear that whereas some species are well able to withstand a fair amount of silting, others are killed off by very little. Silt is evidently a limiting factor, and it is in turn correlated, of course, with water movement.

In addition to the traverses at Low Isles, small isolated areas on the Outer Barrier Reef were examined and are described here for comparison.

* British Museum (Natural History). Great Barrier Reef Expedition, 1928–29. Scientific Reports, vol. 3, No. 10: Ecological Surveys of Coral Reefs. By Dr. S. M. Manton. Pp. 273–312 + 16 plates. (London: British Museum (Natural History), 1935.) 10s.

The different physical conditions there are primarily responsible for the change in the character of the fauna as compared with that at Low Isles.

This report is most beautifully illustrated by a series of large-scale maps in picture form, showing in detail the distribution of corals and other organisms on small selected areas of the traverses or on portions of the Outer Barrier Reef. These maps show evidence of lavish care and attention both in the preliminary drawings and in the measurements necessary to produce them, as well as in the skilful draughtsmanship that has produced the finished plates. They should be of great value to all students of coral reef ecology.

# Diesel Fuels and Engineering

AT the first overseas meeting of the Institution of Petroleum Technologists held in Holland on May 8–11, a series of papers was read on diesel fuels and diesel engineering.

Among papers presented for discussion was one by Ir. W. Hupkes on "Diesel-Electric Traction on the Netherlands Railways". Of particular interest in this paper is a clear exposition of facts leading to selection of diesel-electric trains for the frequent and regular conveyance of passengers in the Netherlands. The triple-articulated diesel-electric engine chosen was designed specifically to meet circumstances of accommodation, coupling, speed, rapid acceleration and open-air storage when not in service. Full details are given of the car arrangement ultimately decided upon, motive power, performance, braking, automatic coupling, heating and ventilation.

Ir. G. J. Lugt in his paper on the "Design of Fuel Injectors for Diesel Engines" described the two methods of fuel injection, mechanical and pneumatic, and indicated the function of the injector as being the distribution of the fuel over the air in the compression space of the cylinder. He then devoted himself to closed mechanical injectors as being almost exclusively used by diesel engineers. He concluded with the remark that there is now little need for individual design of injectors for diesel engines as they have become to all intents and purposes a standard fitting.

Mr. C. H. Barton in his paper on "Diesel Fuel Specifications" pointed out the necessity for such specifications in the classification of fuels into grades and in the indication of desirable properties in particular grades. He described tests commonly adopted in fuel specifications and indicated their significance.

A joint paper by Ir. G. D. Boerlage, Ir. J. J. Broeze, L. J. Le Mesurier and R. Stansfield, on the "Correlation of Tests on the Ignition Quality of Diesel Fuels, carried out at Delft and Sunbury", was the outcome of differences found in the two laboratories regarding the rating in terms of cetene numbers of some commercial fuels. A great deal of work was involved before agreement was reached, and the results of this collaboration are of major importance as providing a feasible technique for the accurate determination of ignition quality of diesel fuels.

# Training of the Engineer in the U.S.A.

A PAPER on the training of the young engineer by R. E. Hellmund, of the Westinghouse Company, just published by the American Institute of Electrical Engineers, takes into account the changing conditions of the industry recovering from the great depression. It was discussed at the summer convention of the American Institute of Electrical Engineers at Pasadena on June 26, 1936.

The disorganization of industry brought about in the United States and elsewhere by bad times has resulted in many radical suggestions being made in connexion with engineering education, and Mr. Hellmund has noted a tendency to discard good methods with bad. Even if it were desirable for the good of humanity to retard the introduction of labour-saving devices with the object of avoiding unemployment, it would not be advisable. Every engineer employed in any competitive industrial enterprise must, if the business is to survive, reduce costs by every means in his power. Even the greatest advocates of Government control have never suggested the elimination of competition in industry. He states that the only way the engineer can help to diminish unemployment is to create new products for which there will be a demand. This will enable costs to be reduced, and at the same time the population will benefit by the improvement. He suggests, therefore, that economics be given a more prominent place in engineering education. Psychology is another subject of study that will assist the engineer in carrying on his work effectively under modern conditions. The question arises, in what way should the syllabuses of the colleges be best altered so as to accomplish this.

Mr. Hellmund has noticed that young engineers in industrial organizations frequently become so absorbed in the solution of an interesting problem that they neglect to study its economic and commercial aspects. During the depression, it was more than ever necessary to focus attention on this side of the question. In many college curricula, courses in economics are included, but they are given by the department of economics, and much of the work covered at present is far removed from the practical applications encountered by the engineer in his everyday work. He concludes that the engineering schools should offer special abbreviated courses which show how the basic laws can be applied in practice.

Psychology is another subject that in several ways can assist the engineer in carrying on his work effectively. In industrial organizations, work cannot be done efficiently without a thorough knowledge of human nature. The depression has emphasized the importance of this. Although the study of psychology will not correct all personal shortcomings, yet it seems the only practical way by which the colleges can bring about improvement. A few specific lectures on this subject would be helpful in a school of engineering, but, at least at first, they should not be made compulsory.

Graduate courses at college prior to entering industry are, in Mr. Hellmund's opinion, only of limited value. It is dangerous for an engineering student to stay too long in a college atmosphere. The profession is one which requires courage and initiative, qualities which are rarely developed in college life by the type of students who take postgraduate courses. It is true that there are a few kinds of highly technical research work which might advantageously be done at a postgraduate course at the university. If the postgraduate work is undertaken because the graduate is unable to find immediate employment in industry, it is advisable not to take courses in the specific subjects of the branch of engineering contemplated but in affiliated subjects. For example, an engineer wishing to enter research work on electrical subjects would do well to take additional mathematics, physics and physical chemistry. One intending to take up practical design would find additional work relating to the materials used in his type of engineering, such as chemistry and metallurgy, very useful. The opinion is expressed that it is generally better for the young engineer to enter industry as soon as possible after completing his undergraduate course.

During the depression, the business of many industries decreased by 20–60 per cent of previous levels. The heavy industries were as a rule the most severely affected. During the lowest level, it was difficult for engineering graduates to find employment. Now industry is increasing and the prospects are good. As a rule, employers can engage their old employees with specific experience and ability, but some of these have taken up activities outside the engineering industry and so there is a demand for young engineers. In some cases the latter have a great advantage over the older men, as they know the latest theories and methods and have not forgotten how to handle the technical details in calculations, laboratory and similar work.

Mr. Hellmund has noticed that about seventy per cent of all engineering graduates express a desire to go into power transmission work, the design of large machinery, railway electrification and similar work. As they all cannot get employment in this direction, it is necessary to persuade some of them to take up other activities. The author can recall no instance where the men who took his advice afterwards regretted their action, as they soon found that there are very interesting and important problems in almost every branch of engineering. The young engineer need not fear to enter work not entirely in accord with his wishes. He should prepare himself to handle effectively the work assigned to him.

# Chemistry of Fibres

THREE papers read at the annual conference of the Textile Institute held in London on June 3–6 dealt with various aspects of the chemistry of fibres.

One of these was a comprehensive summary by G. F. Davidson of current theories of the molecular structure of cellulose. After an outline of the chemical and physical evidence in support of the molecular chain theory, the membrane theory of Hess was dealt with critically; the author, in common with most other investigators, appears to prefer the former. Six methods for the determination of the molecular weight of cellulose and its derivatives were then described, and the difficulty of correlating and interpreting the resulting values was emphasized. Thus, chemical determinations of end-groups give the 'molecular weight' of the largest unit within which the atoms are bound by primary valencies; osmotic pressure and ultra-centrifuge methods measure only particle size and, therefore, depend on the degree of aggregation of the molecules; whilst viscosity measurements must be standardized against an absolute method.

The second part of the paper described how the methods devised by the British Cotton Industry Research Association for the preparation of modified cotton cellulose by the action of acids and oxidizing agents have enabled evidence in support of the chain theory to be obtained.

A second paper, entitled "Wood Pulp for the Rayon Industries", by L. Hebbs, contained some interesting side-lights on the influence of the early work of the late C. F. Cross. Thus, it was pointed out that so long ago as 1904 a pulp with an $\alpha$-cellulose content of 88·8 per cent had been produced by mercerization with alkali. Moreover, in 1906 an analytical method for the determination of $\alpha$-cellulose was outlined, which is essentially the same as that used to-day. The correlation of the copper number and the cuprammonium- and viscose-viscosities with the strength and cellulose purity of pulp was then discussed, the relationships being illustrated graphically. The elimination of resinous matter in the manufacture of wood pulp is greatly assisted by removal by washing and screening of the small sacs, medullary rays and short fibres in which it is concentrated, and by bleaching the pulp in several stages. Rapid replacement of cotton linters by wood pulp is expected.

In the third paper, Dr. R. Cuthill discussed the sorptive properties of the silk fibre, which are of considerable importance both from a theoretical and a practical point of view. Gases and vapours, non-electrolytes in solution and pure liquids, suspended solids, electrolytes and dyes were dealt with in turn.

## Canadian Work on Dermatophyte Fungi

A NUMBER of papers by members of the University of Manitoba form an admirable review of modern knowledge of the dermatophytes, or fungi which produce ringworm and favus diseases of human skin. The general mycologist will find many features of interest in this field of specialist endeavour, and Dr. P. H. Gregory has provided adequate summaries[1].

The outstanding characteristic of a dermatophyte is that it can utilize the highly insoluble scleroprotein *keratin* as a source of energy. This is apparently accomplished by means of a keratolytic enzyme secreted by the organism. Such fungi may be introduced to unkeratinized parts of the body ; several have, indeed, been re-isolated from the blood-stream ; but they do not seem to be able to parasitize any organ but the skin.

A very high degree of specificity is found. Some species of the genus *Microsporon* produce ringworm of the scalp in children, but not in adults ; the lesions disappear naturally at puberty. Certain species parasitize the hands and feet, whilst others attack only the hairy parts of the body. *M. audouini* infects man, but not other animals. This limited pathogenicity cannot be due to chemical differences between the various sources of keratin, for a number of species will attack that substance from all sources—scalp hair from children and adults, pubic hair, human nails, porcupine quills and snake scales—when it is dissociated from living tissues.

The localized fungal infection, known as a 'mycosis', may not be the sole effect of the organism upon the host. 'Mycids' may occur. These are secondary lesions of a non-parasitic nature, but definitely associated with the presence of the fungus in another part of the body. The very great emphasis on the need for keratin as food for the parasitic dermatophytes is rather striking, as they are also saprophytes of a taste sufficiently catholic to include such diverse food substances as tinned oysters, straw, cereal grains and a wide variety of synthetic media. Their characters are also changed in the saprophytic phase, and very numerous forms of organs appear in artificial culture which are unknown in the state of natural parasitism. The spontaneous degeneration known as pleomorphism often occurs in the saprophytic phase ; but infection of animals has been accomplished from fungi which have been grown saprophytically upon keratinized tissues *in vitro* for some time. The need for investigation of natural sources of infection raises some very interesting problems for the field mycologist. From what saprophytic substrata can a dermatophyte proceed to attack a human subject ? How is the transference to the host accomplished, and by what kind of spore ?

Classification of the 880 species of dermatophytes at present described is very difficult. Four different systems of grouping have been suggested, but the general mycologist would only be at home with that of Langeron and Milochevitch, which includes all the ringworm and favus fungi in the Gymnoascaceæ, though perhaps, as yet, with insufficient justification. The system originally proposed by Sabouraud, and revised in 1929, is still the most useful to medical men. It also possesses sufficient parallels with the classification of the Fungi Imperfecti to enable it to be adapted mycologically as future researches should dictate. The local dermatophyte floras of various parts of the world are being studied, and Drs. A. M. Davidson and P. H. Gregory have published their quota[2]. The same two authors have also helped to simplify the problem of classification by their proof[3] that the so-called 'mosaic fungus', often associated with ringworm attacks, is in reality an intercellular deposit of cholesterol crystals. Dr. Gregory discusses reports of the discovery of asci in dermatophytes, and considers their possible relationships with other fungi.

Certain species of dermatophytes cause a green fluorescence to appear on infected hairs when viewed in ultra-violet light. This is due to the presence of a water-soluble substance, and the fact is used to facilitate the diagnosis of ringworm. Dr. A. M. Davidson, S. A. Boyd and C. P. Haltalin have described a very simple and convenient apparatus for this purpose[4]. The work, which is the result of co-operation between a research worker, a physician and an electrical engineer, is typical of the determined team spirit which is very obvious in the publications of the Manitoba workers on dermatophytes, and should not fail to yield results of practical value to humanity.

[1] "The Dermatophytes", *Biol. Rev.*, **10**, 208 (1935) ; and "The Parasitic Activity of the Ringworm Fungi", *Trans. St. John's Hospital Dermatological Society*, 56–65 (1935).

[2] "The Dermatophytes of Manitoba, Canada", communicated to the Ninth International Congress of Dermatology, and appearing in the first volume of deliberations of the Congress. (Budapest : "Pátria'-nyomda. R.-T.".)

[3] *J. Amer. Med. Assoc.*, **105**, 1262–1264 (October 19, 1935).

[4] *Canad. Med. Assoc. J.*, **33**, 534–536 (1935).

## Educational Topics and Events

EDINBURGH.—Prof. James Ritchie, regius professor of natural history in the University of Aberdeen, has been appointed to the chair of natural history, in succession to the late Prof. J. H. Ashworth.

The degree of Doctor of Science has been conferred upon the following: A. B. Brown, for a thesis entitled: "Studies in Cambial Activity" ; Sasindra Chandra Dhar, for a thesis entitled: "On certain Investigations of the Properties of the Functions of Mathieu, Whittaker, Weber and other Confluent Hypergeometric Functions : On the Uniformization of Algebraic Curves, and on certain Electromagnetic Waves in Gravitational Fields in Relativity" ; Nancy M. Galpin, for a thesis entitled : "Biological and Statistical Studies on the New Zealand Romney Lamb, with reference to Relative Growth Gradients" ; J. M. Stagg, for papers on "Terrestrial Magnetism, with special reference to the Magnetic and Non-photographic Auroral Data brought back from Fort Rae, North-West Canada" ; J. Carmichael, for a thesis entitled : "Investigations into Tuberculosis in Uganda" ; Philippus L. le Roux, for a thesis entitled : "Observations on Schistosomiasis and Paramphistomiasis in Sheep, and Notes on the Morphology of Helminths from Mammals and Birds in South Africa".

LONDON.—Dr. W. J. Hamilton, since 1935 lecturer and deputy director of anatomy at St. Thomas's Hospital Medical School, has been appointed University professor of anatomy (St. Bartholomew's Hospital Medical College).

It has been resolved to institute a B.Sc. degree in chemical engineering for internal students in the Faculty of Engineering.

The following D.Sc. degrees have been conferred : In agriculture, on P. H. H. Gray, of the Rothamsted Experimental Station ; in botany, on W. A. Roach,

a recognized teacher at the East Malling Research Station; in botany, on F. C. Steward, of Birkbeck College; in fuel technology, on R. J. Sarjant, of the Imperial College (Royal College of Science); in history, methods and principles of science, on Dr. Douglas McKie, a recognized teacher at University College; in physical chemistry, on C. F. Goodeve, a recognized teacher at University College; in zoology, on R. J. Ortlepp, of the London School of Hygiene and Tropical Medicine.

Alexander Haddow has been re-appointed to the Laura de Saliceto studentship for the year 1936–37. The Sir George Jessel studentship in mathematics for 1936 has been awarded to W. J. E. Butler, of University College.

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BEIT fellowships for scientific research, tenable at the Imperial College of Science and Technology during the academic year 1936–37 have been awarded as follows: extensions of fellowships to R. Walls, for the continuation of his research on the metamorphic rocks of north-east Scotland, under the direction of Prof. P. G. H. Boswell; E. W. Hewson, for the continuation of his research in meteorology, more especially the detailed structure of discontinuities between air masses as occurring in England and Canada, under the direction of Prof. D. Brunt. New fellowships have been awarded to: E. K. Woodford, of Olds School of Agriculture, Alberta, 1929–30, and the University of Alberta, 1930–36, for research in the physiology of plants, with special reference to problems of plant growth and metabolism, under Prof. V. H. Blackman; Dr. N. Kemmer, of the Universities of Göttingen and Zurich, for mathematics research, using the ideas and formalisms of quantum theory (especially quantum electrodynamics), under Prof. S. Chapman.

A NEW handbook of information about facilities available for students from other countries at university institutions in Great Britain and Ireland has been published by the Universities Bureau of the British Empire (88a, Gower Street, London, W.C.1). In the sixty-four pages of this pamphlet are set out, succinctly but lucidly, indications of conditions of admission, costs of living, fees and other charges, courses and subjects of study, special courses for overseas students, vacation courses, social amenities, some features of university administration and notes on research facilities and open scholarships. Under the heading "Cost of Living", overseas students are strongly recommended to obtain entrance to hostels, as they provide contacts which are not readily obtainable in the seclusion of lodgings and boarding-houses or even in families where students are received as paying guests. The list of courses of study comprises those which experience has shown may be of special interest to overseas students and research workers. Among special courses for overseas students mention is made of an offer by Ashburne Hall of Residence for university women, Manchester, of places at reduced fees (£13 for the term or £1 5s. per week) to foreign women students prepared to give some conversational French, German, Italian or Spanish to students resident in the Hall. Other institutions which offer special courses for overseas students are: University College, London; London School of Economics and Political Science; University College, Exeter; University College, Nottingham; and University College, Southampton.

# Science News a Century Ago

### Progress on the Liverpool and Manchester Railway

AT a meeting of the proprietors of the Liverpool and Manchester Railway held in Liverpool on July 27, 1836, it was reported that the receipts for the half-year ending June 30, 1836, had been £109,355, and the expenses £69,953. It was also reported that the tunnel at the new station, in Lime Street, Liverpool, would be opened for public business on August 15, and that this new means of approach to the railway would prove of great public accommodation. The expense of erecting this station and the one at Edgehill, which was constructed on a most magnificent scale, amounted to about £150,000. The directors also intended, it was said, to erect a commodious station in Manchester similar to the one at Liverpool, and with that view extensive premises had been purchased in the neighbourhood of Water Street, near the River Irwell.

### The Euphrates Expedition

IN a supplement to the *London Gazette* of July 29, 1836, a dispatch from Colonel Chesney to the India Office was published describing the loss of the steamer *Tigris*, the smaller of the two steam-vessels with which he was descending the Euphrates to the Persian Gulf. His dispatch was dated May 28, 1836, from the steamer *Euphrates* at Anna. All had been going well, he said, up to May 17, the survey having been carried 509 miles down the great river and "all was continued prosperity up to the afternoon of the 21st inst when it pleased God to send the calamitous event of which it is now my duty to give a feeble sketch. A little after 1 p.m. the flat boats being a little ahead, and the *Tigris* leading the *Euphrates*, a storm appeared bringing with it, high in the air, clouds of sand from the west-north-west quarter. At the moment we were passing over the rocks of Is Geria (deeply covered) and immediately after made a signal for the *Euphrates* to choose a berth and make fast. . . . The *Tigris* was immediately directed towards the bank against which she struck without injury but with so much violence as to recoil a distance of about eight yards." The wind then veered, said Col. Chesney, the water came aboard and the vessel soon sank. Col. Chesney escaped, but no fewer than twenty officers and men were drowned. The storm only lasted about 12 minutes. In spite of the disaster, which included the loss of instruments, journals and surveys, the work of the expedition was carried on by the *Euphrates* alone, "the party continuing their survey to Bussora hoping to demonstrate the speed, economy and commercial advantages of the river Euphrates".

### Medicine in Denmark

ON July 30, 1836, the *London Medical Gazette* published the following note: "Every physician and surgeon in Denmark gets an education which qualifies him to maintain the dignity of his profession, as a worthy member of a class that is generally considered to be one of the most respectable and most liberal. The Danish medical men are usually held in high esteem. . . . Danish physicians and surgeons are so honoured abroad that very often Swedes come to Copenhagen in order to be treated by them. Mountebanks and quacks among the Danish medical men

are rare. . . . The learning and scientific intercourse among the medical men in the Danish capital are supported by two medical societies. In their general methods of cure the Danish medical men do not commonly use but rather shun heroic remedies: as true sons of Hippocrates they follow his maxims in studying Nature and in endeavouring in all their treatment to obey it and to sustain the *vires medicatrices* not disturbing them by too active medicine".

### The Siamese Twins

*The British and Foreign Medical Review* for July 1836 gives the following account of this interesting pair, who were then in Paris: "The connecting band united them at first face to face, but constant traction has so changed its direction that they are now side by side. Its length above is two inches, below nearly four; from above downwards it measures three inches, and its greatest thickness is one and a half inch. . . . The band is formed superiorly by the xiphoid appendix and by some of the cartilages of the ribs, and presents inferiorly the cicatrix of the umbilicus: the cavities of the two chests do not communicate, but the abdominal cavities do. . . .

It has been proposed to divide the band, but, if this description be correct, any incision would open the peritoneum; such a proposal is very disagreeable to the twins, who have often said they have never seen any single individual so happy as they are united. Their names are Eng and Chang, and they were born in May 1811 in a small village on the coast of Siam, twenty leagues from Bankok, of Chinese parents. They have the Chinese features; the internal angles of the eyes slightly drawn down, skin yellow and hair very black; they are extraordinarily alike, only Eng is a little larger and stronger, and Chang appears to rest more willingly on his brother. They are five feet in height, well proportioned and of great muscular strength; they are very agile, they walk and run rapidly, and can swim as well as a single person. Their intellectual faculties are well developed. They understand English and speak it perfectly, but they have forgotten their native tongue, which is not to be wondered at, as they never speak to each other except sometimes asking a question. They have both an equal knowledge of English. Two persons have endeavoured to converse separately with each at the same time, but both turn invariably to one speaker, and converse alone with him. They suffered from ague in America; the attack commenced at the same time in both, and the stages of the disease exactly corresponded, so that they experienced rigors, heat and sweating at the same moment. Chang also had pain in his side, during which his brother was uncomfortable, and when Chang was being bled, Eng felt indisposed.

Their taste for food, for persons and things is similar, what pleases one, pleases the other; they both experience hunger and thirst, go to sleep and wake at the same instant; one is never awake while the other sleeps, and to wake them it is only necessary to touch one. During sleep they often change their position by one rolling over the other without waking. There is the utmost uniformity in their motions, as if both were influenced by one will. They have never been known to be angry with each other; the one who wishes to perform any act, makes no sign to the other, who, notwithstanding, concurs without the slightest hesitation".

## Societies and Academies

### Edinburgh

#### Royal Society, July 6.

B. G. SHAPIRO and H. ZWARENSTEIN: Relation of the pituitary gland to muscle creatine. The creatine content of the thigh muscles of *Xenopus lævis* is about 400 mgm. per 100 gm., the extreme limits for normal animals, male or female, being 40 mgm. above or below this figure. Six months after total removal of the pituitary gland, the muscle creatine content is found to be about 320 mgm. per 100 gm. The same result follows the removal of the anterior lobe alone. The drop does not follow immediately after operation, and is still comparatively slight after three months have elapsed. Injection of anterior lobe extract into normal toads of the same species raises the muscle creatine level by thirty per cent. This effect is tissue specific.

EDITH A. T. NICOL: The fauna of the brackish water lochs of North Uist. These lochs lie at different levels and show all conditions between lochs entered by every tide with a salinity of more than thirty per mille and those entered by only the highest tides with a salinity of about two per mille. The $pH$ varies between 7·8 and 9·9 in spite of the low $pH$ of the fresh-water and the alkali reserve is often below 0·0010 $N$. The fauna is unusually rich owing to the varied conditions of salinity and substratum, and consists of 59 marine, 24 fresh- and 25 brackish-water species, as well as 5 euryhaline forms. *Sphaeroma hookeri* is recorded for the first time in Scotland.

P. C. KOLLER: The chromosomes of the male grey squirrel. The diploid chromosome number of the grey squirrel (*Sciurus carolinensis leucotus* Gapper) is 28. The sex chromosomes exhibit very little difference in size. The sex bivalent during meiotic metaphase is invariably asymmetrical, which indicates an obligatory pre-reduction. A deviation of metaphase chiasma frequencies, found in different individuals, is brought about by a different degree of terminalization of diplotene chiasmata. The ultimate cause of the deviation is either genetical or environmental.

F. WALKER and C. F. DAVIDSON: A contribution to the geology of the Faeroes. The eighteen islands of the Faeroes archipelago, 540 square miles in area, are formed of a great sequence of Tertiary basalts and tuffs, 14,000 feet thick. Small volcanic vents, sills and dykes are present, and thin seams of sediments, including lignite, are intercalated with the basalts. Traverses show that the lowest exposed horizons of the plateau, the base of which is not seen, are formed of tholeiitic basalts. These are succeeded by olivine-basalts, and in turn by a vast thickness of porphyritic feldspathic and tholeiitic basalts, capped by ankaramites and olivine-rich lavas at the highest levels. Composite flows, dyke-feeders to lavas, and other phenomena are described, and an extensive bibliography is given. Seven 'superior' chemical analyses of Faeroes rocks are now available.

F. A. E. CREW and P. C. KOLLER: Genetical and cytological studies of the intergeneric hybrid of *Cairina moschata* and *Anas platyrhyncha platyrhyncha*. The two genera are fertile *inter se*, but the hybrid is infecund. The characterization of the hybrid differs according to which way the cross is made. The male hybrid ex *Anas* (male) × *Cairina* (female) is normally equipped sexually but infecund; the female has a

rudimentary ovary, infantile oviduct, exhibits no sex behaviour and in size equals the male. The male hybrid out of the reciprocal cross is infecund and much larger than the female, which has a functional ovary, an oviduct and normal sex behaviour. She lays small eggs which are infertile. The chromosome number of the two genera is probably the same and the larger chromosomes are morphologically alike. In the male hybrid no viable gametes are to be found. Spermatocytes undergo dedifferentiation and nuclear condensation. Multinucleate giant cells in which vacuoles develop and nuclei degenerate are plentiful. The spindle is normal. The sterility of the hybrid would seem to be due to the action of complementary genetic factors which do not affect chromosome pairing but which disturb the relationship of this with spindle development.

HAROLD JEFFREYS: Note on fracture: a note on Dr. E. M. Anderson's paper "The Dynamics of the Formation of Cone-Sheets, Ring-Dykes, and Caldron-Subsidences".

## Paris

Academy of Sciences, June 15 (*C.R.*, 202, 1953–2020).

VITO VOLTERRA: The equations of biological fluctuations and the calculus of variations.

HENRI DEVAUX: The determination of the thickness of the albumen membrane formed between water and benzene, and the properties of this membrane. The interfacial membranes of albumen between water and benzene are monomolecular.

HUGO STEINHAUS: The curve of Peano and independent functions.

M. KAC: Some remarks on independent functions.

R. DE MISÈS: The energy of acceleration of a solid.

PIERRE E. MERCIER: Oscillatory phenomena in suspensions.

LOUIS COUFFIGNAL: The use of binary numeration in calculating machines and nomomechanical instruments.

JEAN LAGRULA: The method of simultaneous pupillary regions. Application of Charles Fabry's method of stellate photometry. Taking four exposures on each plate, by successive rotations of a right angle, relative magnitudes have been determined with an accuracy of 0·005–0·01 magnitude.

L. CHADENSON: A functional space of quantic mechanics.

GABRIEL DUCH: Some relations between the functions of the cohesion forces of liquids and their chemical function at the boiling point under constant pressure.

J. SERPE: The $K$-radiation of boron. Boron prepared by Moissan's method gives a $K$-radiation which has at high temperatures three conductivity electrons per atom. The maximum kinetic energy of these electrons is $20 \pm 2{\cdot}5$ v.

JEAN ROIG and JEAN THOUVENIN: The variation of the optical density of photographic plates with the dryness conditions. A photographic plate, uniformly exposed, never gives uniform darkening. One of the causes of this variation is moisture variation, and results of a quantitative study of this effect is given.

MLLE. ARLETTE TOURNAIRE and ETIENNE VASSY: The influence of the wave-length of the light on the evolution of the latent image. The evolution of the latent image, in plates in which it occurs, is shown to be a function of the wave-length of the incident light.

RENÉ DELAPLACE: Atomic hydrogen and the disappearance of hydrogen in discharge tubes. If the discharge tube is freed from traces of water vapour by cooling with liquid nitrogen for twenty-four hours, the hydrogen does not undergo irreversible contraction, and traces of methane and carbon monoxide are no longer produced by prolonged discharge.

PIERRE SPACU: An argento-mercuric compound. From an X-ray study it is shown that Wöhler's substance $Hg(CN)_2.AgNO_3.2H_2O$ is a definite compound and not a mixture.

ETIENNE CANALS, MAX MOUSSERON, LOUIS SOUCHE and PIERRE PEYROT: The Raman spectra of some substituted epoxycyclopentanes.

PIERRE BRAUMAN: A new type of vanadylsalicylate.

PAUL COUTURIER: The action of mixed organo-magnesium compounds on the aromatic $N$-diethylamides with phenolic function.

RENÉ TRUCHET: Heavy chloroform, $CDCl_3$. This was prepared by the action of heavy water on a suspension of quicklime in chloral, and contained only a small proportion of ordinary chloroform, shown by the Raman spectrum.

GEORGES DENIGÈS: The constant formation of carbonyl derivatives (aldehydes and ketones) of the same condensation in the explosive decomposition of nitric esters.

V. AGAFONOFF: The soil types of Tunis.

JEAN MARÇAIS: The geological constitution of the region to the north of Taza and of Guercif (Eastern Morocco).

MAURICE ROQUES: The cristallophyllian series of the Lespinouse massif, in the neighbourhood of Lacaune.

WACLAW MOYCHO: The independence of the production of proteases and the development of the cell in *Bacterium prodigiosum*. By varying either the $p$H or the amount of phosphate, the development of the bacterium and the production of proteases can be influenced differently. The two processes, at least in this organism, appear to be independent.

RENÉ SOUÈGES: The embryogeny of the Campanulaceæ. The development of the embryo in *Campanula patula*.

MLLE. MARIE LOUISE VERRIER: The purple and visual cells of the fovea of the nocturnal birds and of other vertebrates.

PAUL CHABANAUD: The interbranchial opening of the unsymmetrical teleosteans.

GEORGES BROOKS: Researches on the fluorescence of the skin of the frog, *Rana esculenta*. Study of the mineral substances. The mineral fluorescent substance of the skin of the frog is composed of a complex mixture of mineral salts containing manganese and zinc.

CONSTANTIN LEVADITI and PEREZ HABER: The affinity of the virus of bird plague for the neoplasic (epithelioma) cells of mice.

## Cape Town

Royal Society of South Africa, April 15.

F. G. CAWSTON: Some observations on *Opuntia* used as a larvicide. The mucilage of *Opuntia maxima* was tested in various concentrations, and the effect studied on four different anophelines and *Culex*. The majority of the larvæ rapidly succumbed, but the

mucilage had little effect on those which had reached the pupal stage. There was also an arrest of development of those which were afterwards removed to clean water. The effect of the juice is largely mechanical, and a preservative is needed to prevent decomposition.

VIVIEN ELLENBERGER: History of the Ba-ga-Malete of Ramoutsa. The traditional and historical movements of the Malete tribe, Bechuanaland Protectorate, collected from native tribal sources and from official records. Notes on the social structure, regimental system, national praises and the tribal territory are included.

I. SCHAPERA: Acculturation among the BaKxatla.

FLORENCE RICH: Some diatoms from the Victoria Falls. An account of diatoms contained in the washings of a collection of Dicraea (Podostemaceæ) made just above the Falls, on the rocks at the east side, where these plants are covered by rapid-flowing water in the rainy season. About sixty different species have been identified, most of which proved to have been previously recorded from South or Central Africa. One new species and several new varieties are described and figured.

W. S. S. LADELL: Use of serum as an accessory medium in tissue culture.

H. ZWARENSTEIN: A revised simple technique for the frog test.

V. SCHRIRE and H. ZWARENSTEIN: The pancreas and blood inorganic phosphorus. The normal plasma inorganic phosphorus content of *Xenopus* is 7·1 mgm. per 100 ml. (average of 58 estimations). Temperature has no effect. Pancreatectomy caused a 30 per cent increase six hours after operation. Injection of insulin into normal animals caused a 50 per cent drop four hours after injection.

## Cracow

**Polish Academy of Science and Letters, April 6.**

W. ORLICZ: The $L^M$ spaces.

K. ŠTEINS: The technique of astronomical calculations according to an international inquiry. Some conclusions based on a questionnaire sent out to twenty-two countries relating to various points in astronomical calculations.

S. PIOTROWSKI: A star, probably new, in Gemini.

K. GUMINSKI: The luminescence of barrier anodes of aluminium. A study of the influence of the nature of the electrolyte, of the anode and the electrical conditions on the light emission of the anodes. The results are discussed from the point of view of the current theories of this luminescence.

I. ZLOTOWSKI: The structure and properties of the insulating layers formed on aluminium electrodes during anodic polarization.

K. DZIEWONSKI and J. MOSZEW: The reactions of methyl-*m*-xylyl ketone with compounds of the thiocarbanilide type.

A. KOCWA: The reactions of the alkyl-aryl-pyrazolones and their derivatives of the anil type with carbanil and thiocarbanil.

MLLE. J. BURTAN: The stratigraphy of the Silesian Beskide.

J. CUNGE: The cyto-architectonic of the cerebral cortex in Japanese waltzing mice.

T. VETULANI: The forest tarpan recently introduced into the forest of Bialowieza.

# Official Publications Received

## Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1602 (T. 3503): Influence of a Uniform Jet on the Lift of an Aerofoil. By H. Glauert. Pp. 14+3 plates. 1*s*. net. No. 1679 (1635): Stability of a Monocoque in Compression. By Dr. J. L. Taylor. Pp. 9. 6*d*. net. No. 1681 (1810): Experiments on a Small-Chord Flap on a Clark YH Aerofoil in the Compressed Air Tunnel. By D. H. Williams and A. F. Brown. Pp. 14+8 plates. 1*s*. net. No. 1683 (1926): Cooling of Aircraft Engines, with Special Reference to Ethylene Glycol Radiators enclosed in Ducts. By F. W. Meredith. Pp. 13. 9*d*. net. No. 1684 (2094): Two-Dimensional Flow of Compressible Fluids at Sub-Sonic Speeds past Elliptic Cylinders. By Dr. S. G. Hooker. Pp. 16+4 plates. 1*s*. net. No. 1686 (2038B): Flutter Experiments on a Model Wing fitted with a Dead-Centre Aileron Control. By V. M. Falkner, W. P. Jones and C. Scruton. Pp. 10+7 plates. 1*s*. net. No. 1694 (2018): A Routine Method of Stressing for Three-Ply Covered Fuselages, with Special Reference to some Mechanical Tests on a Particular Fuselage. By H. Davis. Pp. 4+3 plates. 6*d*. net. (London: H.M. Stationery Office.) [306

Report on the Phenological Observations in the British Isles from December 1934 to November 1935. By Ivan D. Margary. (No. 45.) Pp. 299–358. (London: Royal Meteorological Society.) 3*s*. [77

London Shellac Research Bureau. Technical Paper No. 9: Plasticising Lac Films, Part 1. By Dr. Lal C. Verman and Dr. R. Bhattacharya. Pp. 29. (London: London Shellac Research Bureau.) [87

## Other Countries

U.S. Department of the Interior: Office of Education. Vocational Education Bulletin No. 182 (Home Economic Series No. 19): Consumer-Buying in the Educational Program for Homemaking; Suggestions for Teachers of Homemaking in Secondary School and Adult Classes. Pp. xiii+205. (Washington, D.C.: Government Printing Office.) 20 cents. [246

U.S. Department of Agriculture. Circular No. 386: The Wax Moth and its Control. By Warren Whitcomb, Jr. Pp. 14. (Washington, D.C.: Government Printing Office.) 5 cents. [246

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. The Occurrence of Flints and Extinct Animals in Pluvial Deposits near Clovis, New Mexico. Part 3: Geology and Vertebrate Palæontology of the Late Quaternary near Clovis, New Mexico. By Chester Stock and Francis D. Bode. Pp. 219–241. (Philadelphia, Pa.: Academy of Natural Sciences of Philadelphia.) [246

Suomen Geodeettisen Laitoksen Julkaisuja: Veröffentlichungen des Finnischen Geodätischen Institutes. No. 22: Beobachtungsergebnisse; Winkelmessungen in den Jahren 1932–1935. Pp. iii+148. (Helsinki: Suomen Geodeettisen Laitoksen Julkaisuja.) [296

Report on the Zoological Survey of India for the Years 1932–1935. Pp. iii+ix. (Delhi: Manager of Publications.) 1.2 rupees; 2*s*. [296

Memoirs of the Indian Museum. Vol. 11, No. 3: Studies on Indian Jassidæ (Homoptera). Part 3: Descriptions of some New Genera and Species, with first Records of some known Species from India. By Dr. Hem Singh Pruthi. Pp. 101–131+plates 8–9. (Calcutta: Zoological Survey of India.) 1.10 rupees; 2*s*. 9*d*. [296

Allahabad University Studies. Vol. 12 (Arts and Science). Edited by the Vice-Chancellor and the Heads of Departments. Pp. v+188+5 plates. (Allahabad: Senate House.) 7.8 rupees. [296

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series. Vol. 21, Memoir No. 4: Fossil Algæ from the Uppermost Cretaceous Beds (The Niniyur Group) of the Trichinopoly District, S. India. By L. Rama Rao and Dr. Julius Pia. Pp. v+49+6 plates. (Calcutta: Geological Survey of India.) 4.10 rupees; 7*s*. 9*d*. [296

Indian Forest Records, New Series. Vol. 1, No. 3: The Distribution of Sesquioxides, Silica and Organic Matter in Forest Soil Profiles of the Kulu Hill Area. By R. C. Hoon. Pp. ii+347–365. (Delhi: Manager of Publications.) 12 annas; 1*s*. 3*d*. [296

Smithsonian Miscellaneous Collections. Vol. 95, No. 12: The Dependence of Terrestrial Temperatures on the Variations of the Sun's Radiation. By C. G. Abbot. (Publication 3392.) Pp. ii+15. (Washington, D.C.: Smithsonian Institution.) [296

Studies from the Connaught Laboratories, University of Toronto. Vol. 7, 1935. Pp. v+46 papers. (Toronto: University of Toronto Press.) [266

Commonwealth of Australia: Bureau of Meteorology. Results of Rainfall Observations made in Tasmania, including all available Annual Rainfall Totals from 356 Stations for all Years of Record up to 1934, with Maps and Diagrams, and Record of Severe Floods. Published under the direction of W. S. Watt. Pp. 143+4 plates. (Melbourne: Government Printer.) [296

Advisory Department of the Imperial College of Tropical Agriculture. Report of the Agricultural Department, Dominica, 1935. Pp. vi+19. (Trinidad: Imperial College of Tropical Agriculture.) 6*d*. [306

Nyasaland Protectorate: Geological Survey Department. Colonial Development: Water Supply Investigation: Progress Report (No. 5) for the Year 1935. Pp. 20+5 plates. (Zomba: Government Printer.) 2*s*. 6*d*. [306

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## Catalogues

The Gardener's Library: a Comprehensive List of Books on all Branches of Modern Horticulture and a Selection of the Early Literature. (New Series, No. 39.) Pp. 44. The Gardener's Library, 1936 Supplement. Pp. 8. Books, Periodicals and Pamphlets on Geology, including Palæontology, Mineralogy and Mining, with a Supplement of Recently Published Books. (New Series, No. 40.) Pp. 44. Books and Periodicals on Zoology and Botany, including Publications of the British Museum and Works on and by Linnæus. (New Series, No. 41.) Pp. 58. Cryptogamic Botany. (New Series, No. 42.) Pp. [illegible]. Books on Ornithology. (New Series, No. 43.) Pp. 50. (London: Wheldon and Wesley, Ltd.)

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# Electrical Interference with Broadcasting

ONE of the difficulties in ensuring the good reception of broadcast programmes is that many of the various electrical appliances and plant in common use emit radiation which travels to neighbouring radio receivers, and there produces a noisy disturbance mixed with the broadcasting programmes. Some three years ago, the Council of the Institution of Electrical Engineers set up a committee, representative of all sections of the electrical and radio industry, to study this problem, and to make recommendations as to the steps, if any, to be taken to secure the elimination or mitigation of electrical interference with radio reception. This committee, under the chairmanship of Mr. C. C. Paterson, has recently issued its report, copies of which are now available from the Institution of Electrical Engineers (price 6*d*. post paid).

Even before the formation of this committee, the Post Office had commenced the investigation of complaints of interference received from the general public. This work has been continued, and at the present time the appropriate staff deals with about 40,000 complaints a year. As a result of this activity, a considerable measure of radio interference correction has taken place by the voluntary application of the indicated remedies by the owners of the plant or apparatus concerned. The Post Office has no powers in this matter, however, and it has been found that in a small proportion of cases the owners of the offending apparatus refuse to do anything to remove the trouble.

The Committee has expressed the opinion that the desirable objective is defined by the statement that with the field strength of the wanted radio signal of 1 millivolt per metre, when the modulation is 80 per cent, the maximum permissible interfering field strength should be 40 decibels below this value. With this objective in view, a method of measurement has been agreed upon, and instruments have been developed which are capable of indicating with sufficient accuracy the amount of interference caused by much of the electrical apparatus creating trouble. Such apparatus comprises lifts, trolley-buses and trams, household electrical appliances, small electric motors, neon signs, rectifiers and electro-medical apparatus. While at the present time automobile and aircraft ignition systems produce no appreciable interference with broadcast reception on its present wave-lengths, it is possible that trouble may be expected from such systems if they remain uncorrected when television service begins.

During the work of the main committee, a considerable amount of investigation of the problem has been conducted by four sub-committees working in co-operation with the British Broadcasting Corporation, the Post Office, the British Electrical and Allied Industries Research Associations, the British Electrical and Allied Manufacturers Association and various supply authorities and transport undertakings. Also, in view of the necessity of catering for the interests of export trade, representation was obtained on a special international committee set up by the International Electrotechnical Commission in 1934. The British Standards Institution has also set up committees to draft various specifications for components, apparatus and measuring instruments, and these are now in course of publication.

As a result of all this work, the committee now considers it necessary to ensure that all electrical appliances should conform to these specifications and be sold as being free from interference. It

therefore suggests first, that the Electricity Commissioners should be given powers to draw up regulations in respect of any apparatus or plant, new and existing, which may cause interference with radio reception; and secondly, that the Post Office should be given powers to enforce these regulations. No special difficulty is seen in applying the regulations to new apparatus, and the cost of the mitigating devices is in most cases only a small percentage of that of the appliance. In the case of appliances already in use, the question of who is to meet the cost of suppression is considered to be a matter for the legislature to decide.

The report shows that a somewhat complicated subject has been explored in a very thorough and fruitful manner by the co-operative effort of representatives of all the parties concerned, and the conclusions reached and recommendations made will, in general, be regarded as very satisfactory. It will probably be some considerable time before legislation and regulations can be made effective, and in the meantime, the Institution of Electrical Engineers appeals to the general public to continue the goodwill on which the Post Office has been enabled to build up its very successful work in suppressing interference with broadcasting.

# The Medical Curriculum

AT a meeting on May 29, the General Medical Council adopted certain resolutions in regard to professional education. These will come into operation on January 1, 1938, and include the following:

In the pre-registration requirements, it is laid down that every applicant for registration as a student by the Council or for admission to the medical curriculum proper should have passed (*a*), a recognised preliminary examination in general education as laid down in the Regulations of the Council; and, in addition (*b*), an examination or examinations conducted or recognized by one of the licensing bodies.

The subjects to be included under (*b*) are:

(1) One *or* two subjects of general education, other than chemistry, physics, or biology, at a standard higher than that of the preliminary examination, for those who have received their instruction in these subjects before entering universities, university colleges, or medical schools.

(2) Chemistry (theoretical and practical), the elementary principles of general and physical chemistry, and of the chemical combination of elements, including carbon.

(3) Physics (theoretical and practical), the elementary mechanics of solids and fluids, the elements of heat, light, sound, electricity and magnetism.

The examination in biology (theoretical and practical) may be taken either before or after registration as a student.

It will be remembered that about a year ago a conference of representatives nominated by the Universities of Oxford, Cambridge and London; the Royal College of Physicians of London; the Royal College of Surgeons of England and the Society of Apothecaries of London published a report on the medical curriculum (see NATURE, July 20, 1935, p. 90, and Nov. 2, p. 706). The report stressed the need for a continuance of the general education of intending medical students of post-School Certificate stage, and therefore recommended that "the Licensing Bodies consider the possibility of allowing and encouraging exemption from the 1st M.B. examination by means of a Higher School Certificate Examination conducted by any recognised Examining Body in which, in addition to the three principal scientific subjects, a subsidiary non-scientific subject be taken".

The Higher School Certificate Examination is the normal objective of the post-School Certificate student in public and secondary schools, and if the licensing bodies would recognize for the purpose of exemption from the second examination stated in pre-registration requirements those subjects in which a student has passed a Higher School Certificate Examination (chemistry, physics, biology to 'Group' standard and non-scientific subjects to 'Subsidiary' standard), they will impart to the Higher School Certificate examination a value which has been questioned in the past by so many intending medical students. The recognition would also lead to greater uniformity in the education of post-School Certificate students in the schools, and would go a long way towards removing the evil of segregation of intending medical students from the rest of the school.

# Teaching Elementary Physics

**(1) College Physics**
By Prof. C. E. Mendenhall, Prof. A. S. Eve and Prof. D. A. Keys. Pp. xi+592. (Boston, New York, Chicago and London: D. C. Heath and Co., 1935.) 3·76 dollars.

**(2) A Complete Physics written for London Medical Students and General Use**
By W. H. White. Pp. vii+848. (London: Richard Clay and Sons, Ltd., n.d.) 15*s*.

**(3) Experimental Electricity**
By M. M. Das. Pp. xvi+334. (London: English Universities Press, Ltd., 1935.) 4*s*. 6*d*.

**(4) Light and Sound**
By H. G. Lambert and P. E. Andrews. (Elementary Science Series.) Pp. vii+183. (London: University Tutorial Press, Ltd., 1935.) 2*s*. 3*d*.

**(5) School Certificate Examples in Physics**
By Dr. W. G. Davies. Pp. vii+176. (London: Edward Arnold and Co., 1935.) 2*s*. 6*d*.

**(6) Laboratory Manual in Physics**
By Prof. A. A. Knowlton and Prof. Marcus O'Day. Second edition. Pp. xi+137. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 7*s*. 6*d*. net.

**(7) Praktische Physik:**
zum Gebrauch für Unterricht, Forschung und Technik. Von F. Kohlrausch. Siebzehnte vollständig neu bearbeitete Auflage. Herausgegeben von F. Henning. Pp. x+958. (Leipzig und Berlin: B. G. Teubner, 1935.) 32 gold marks (inland); 24 gold marks (abroad).

THE present system of examinations has recently been subjected to much adverse criticism, and the possibility that good may have arisen from the system seems rarely to be considered. This system in general has led to systematic teaching, and the results of this are clear in the present standard of training in elementary physics compared with that of twenty years ago. Physics was then in many schools rather a neglected subject, whereas there is now a reasonably high general level of attainment. Of course, it is always possible to sacrifice the teaching so that passing an examination becomes its main purpose; but the examination can scarcely be held wholly responsible for this evil.

The need for systematic teaching has in turn produced the need for suitable text-books, and while most of these keep an eye on some examination, they generally contribute something to the advancement of the subject. A general need has been created for the production of books of an elementary nature calculated to help beginners in the subject. The frequent publication of new books and fresh editions indicates a lively interest in teaching the subject. The variety shown in their methods of treatment assures us that the subject will not become too standardised in character, each teacher bringing some fresh ideas to the subject as the result of his own enthusiasm. No one but an enthusiast who has at least a few new ideas to communicate is likely to embark upon the task of writing a text-book of physics. Thus each of the books now considered should in its own way add something to the teaching of the subject, and particularly to the originality of the treatment.

(1) "College Physics" by Prof. C. E. Mendenhall, Prof. A. S. Eve and Prof. D. A. Keys provides an introductory course in the subject, and its most striking feature is the logical and clear development of physical ideas throughout the work. It is surprising how much ground is safely covered in a book which is not unduly bulky. The authors rightly recognise that there can be no real distinction between 'classical' and 'modern' physics, and do not hesitate to introduce new ideas which take their place naturally with the rest. The effort which the authors have made to show that many of the basic ideas of modern theory are not essentially more difficult to follow than those of the older physics has certainly been worth while. There are interesting chapters on the constitution of matter, vibrations and waves, radio, photoelectricity, radioactivity and atomic structure, and the whole is written from a modern point of view. The readable section on thermodynamics includes an account of steam and internal combustion engines and refrigerating machines.

To cover so much ground in one book has meant the careful pruning of unessential material. The result is that the book is very pleasant and interesting to read because the development of important ideas is always kept in mind. Many students who have taken more advanced courses in physics would do well to read and master this fundamentally simple account, so as to obtain a connected view of the subject. Although it is the work of three authors, the outlook and method of treatment are very uniform. The book is attractively printed with many valuable diagrams.

This book, which tells what physics is about, is easier and more interesting to read than many popular works on the subject, so that the general reader could profit from its perusal. There seems

little doubt that it will obtain a well-deserved success.

(2) "The Complete Physics" by Mr. W. H. White is essentially different in character, and has been written chiefly for the use of London medical students, frequent references being made to their examination requirements. The book covers the usual ground of an elementary text, but the many references to practical applications have been chosen to be of special interest and of value to the one class of students. Although it has clearly been written for examination purposes, nothing could be less like a typical 'cram' book on the subject. Any student who passes his examination under its friendly guidance will deserve his success. The author has tried to recapture something of the attractions of the old natural philosophy and many interesting applications show that he brings this attitude to bear on the whole subject. It is written with the unconcealed enthusiasm of an experienced teacher with a fresh and youthful outlook. The writing is in a frank and conversational style unusual in scientific text-books, and this may prove rather bewildering to the weaker students who are seeking to obtain the simple essentials of the subject. It seems likely that the book will serve those best who have already a fair elementary knowledge of physics, and it should be invaluable in enabling such students to apply their knowledge to medical purposes. Every teacher of medical students should read the book, as he cannot fail to extract much new matter from it. It brings an attitude to the subject differing greatly from that generally produced by examination requirements.

Many of the references are of a recent character and the book deals adequately with the modern developments of the subject. The author clearly recognises the dangers of his style and at the end says "maybe I have told you twice too much". Maybe he has, but much of the material is of an unusual character which cannot easily be found elsewhere. This unusual book ends with a photograph of the author at the end of the last chapter. It is a fitting way of ending a work essentially personal in character, the writing of which has clearly been a labour of love.

(3) The work of Mr. M. M. Das is suitable for students in technical colleges and secondary schools. The author makes it clear that the book has not been written with the sole object of enabling students to pass examinations; but the matter is intended to be adequate for matriculation, professional entrance, and most technical college examinations. If the book is read with the help of a teacher who will stress the fundamental principles, it should serve to excite the curiosity of the student and create enthusiasm by the variety of the practical applications of the subject. Thus there are notes on the manufacture and heat treatment of iron and steel, interesting chapters on electromagnets with practical applications, on electrolysis and its applications, and on the use and care of electrical apparatus.

It seems a pity even in an elementary book to express the units of resistivity in "ohm per cm. cube", after it has been correctly defined; but no doubt the author will think fit to change this in a later edition. The book contains rather more technical information than is generally required in a secondary school, but this would probably cause it to have added interest to many boys.

(4) The book on "Light and Sound" by Mr. H. G. Lambert and Mr. P. E. Andrews is intended as a first course for the lower science forms of public and secondary schools, and for those preparing for the general science examination of the School Certificate. It deals with the theoretical principles, and gives a series of experiments which might be performed. This suggests that it is intended for the book to be worked through systematically by both teacher and pupils. Whether any experienced teacher would be willing to submit to such restrictions in his methods is very doubtful. At such an early stage, it is inevitable that pupils will be more interested in practical cases and applications of the subject rather than in the logical presentation of general principles. If it is necessary for the pupil at this stage to have a text-book giving a clear and concise account of the subject, then this book meets the case admirably. But are such text-books really required? The excellent and interesting scientific information now available in children's magazines seems to offer greater attractions.

As a means of summarizing and revising what has already been taught, this book would serve a very useful purpose. It would also be of value for a young teacher who is mapping out such a course of elementary lessons.

(5) Dr. W. G. Davies's book contains more than nine hundred examples including both numerical and descriptive exercises of the type usually set in School Certificate examinations. No one will question the value of numerical exercises even in the elementary branches of the subject. Experience shows that the candidate who can work out such examples correctly has a firm grasp of the subject. The experienced teacher will generally have a set of suitable exercises with which to illustrate and drive home the principles of the subject, but this book cannot fail to provide some new ideas.

Some of the questions are in the form of exercises on laboratory work, which may assist in avoiding the common fault of the student who knows all about the experimental details while failing to understand the underlying purpose. Of course,

if such exercises are used instead of laboratory measurements they would constitute an evil which is certainly not contemplated by Dr. Davies.

There is doubt as to what extent such a book of examples should be left in the hands of the student. Care will be required in the selection of examples by the teacher, and no student will be subjected to the lifeless drudgery of working through the whole book. Many text-books do not give suitable examples so that this book of exercises, many of which are of considerable physical interest, cannot fail with proper care to be of real service.

(6) The "Laboratory Manual in Physics" by Prof. A. A. Knowlton and Prof. Marcus O'Day provides a series of experiments suitable for a first-year university course. Every laboratory tends to have its own rather specialized apparatus which has gradually grown up with it. This constitutes a difficulty when considering the general adoption of any text-book of practical physics. The extent to which such a book would be useful to the student depends upon how far the available apparatus corresponds to that actually described. The book, however, would be of considerable assistance to any teacher arranging an elementary course.

The authors have aimed at producing more than a mere collection of experiments. They have tried to give a selection of exercises covering the more important concepts, and rightly stress the ideas involved, more than the manipulative details of the exercises.

The book covers all the ordinary branches of physics, including exercises on the balance and on electrostatics which are frequently omitted. It is well produced and pleasant to read.

(7) The publication of the seventeenth edition of Kohlrausch's "Practical Physics" is a matter of importance. The general editor, Dr. F. Henning, and his numerous collaborators have produced a new and thoroughly revised work. This book is different in character from those which we have been considering, as it can scarcely be said to deal with elementary physics. It is suitable for advanced students, and as a general reference book for those engaged upon research in either pure or technical physics. In addition to the detailed descriptions of certain experiments, it contains valuable general summaries of experimental methods and numerous recent references to original papers. Such references would be of the greatest help to those beginning a new line of investigation. The book opens with a general introduction on units and measurement, and then deals with mechanics and sound, heat, optics, electricity and magnetism, corpuscles and energy quanta, and concludes with a reasonably comprehensive series of tables. There seems no doubt that this edition will be as successful as its predecessors. T. L. I.

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# Mycoses of Man and other Mammals

**Medical Mycology:**
Fungous Diseases of Men and other Mammals. By Prof. Carroll William Dodge. Pp. 900. (London: Henry Kimpton, 1936.) 42*s*. net.

IN this work, for which Prof. C. W. Dodge is to be congratulated, the dermatologist will find a mine of information on the technical mycological details of the causative organisms which underlie that immense number of diseases of the skin and other regions of the body grouped under the generic term 'mycoses'. These are subdivided into sub-groups, such as the dermato-mycoses, etc.

In the opening chapter, the author gives a good description of the different elements which comprise the several types of fungi. In dealing with the physiology of fungi, the importance of the hydrogen ion concentration of the media and the action of buffers is stressed. The discussion of the exact meaning of both these terms, somewhat baffling to the average medical man, is clear and understandable.

The author takes a wide view of the different species described under the various genera. He indicates that many of the former may eventually be proved to be synonymous: nevertheless, the worker in mycology is given the benefit of all the published views of many authors to guide him in his studies without obtruding the author's personal views to the exclusion of the general knowledge of the subject.

Another prominent feature of this book is the extensive bibliography given after each section, which is particularly useful in following up research on an individual organism.

The reviewer is struck by the clear unbiased discussions concerning each type of infection: a good example is the preliminary dissertation on malassezia. After a general résumé of the accepted facts of distribution of lesions, embryology, age and sex incidence, etc., the author shows how the different varieties of malassezia attack the sebaceous glands, and exposes many fallacious

schisms perpetrated by some of the less recent authors, who did not realise the importance of fungi in so many of the diseases under review. This is followed by the reference to some 1,375 articles bearing on the subject—a truly comprehensive and international bibliography.

Another section of the work of particular interest to the dermatologist is that on the Trichophytoneæ. The different clinical types are described with methods of prophylaxis. Many cultural methods are given to suit the various types of specimen and organism, and the therapeutical agents in common use are enumerated from two points of view: first, the drugs used by dermatologists in practice, and secondly the result of many inhibitant substances used *in vitro* in laboratories. These do not coincide, because of the differences of the conditions *in vivo* from those obtaining *in vitro*. This is attributed largely to differences in the *p*H value of the horny layer of the skin to which the lesions are confined, temperature of this layer and of the media, and the oxygen pressure present. The Trichophytoneæ are frequently carried in the blood stream, but do not develop in tissues other than the horny layer of the skin. The experiments proving this contention are well described, as are the allergic phenomena in infections with the Trichophytoneæ.

Aspergillaceæ and Actinomycetеæ are dealt with in the same complete and thorough manner.

In the reviewer's opinion, this work is a very important contribution in which an immense amount of the relevant bibliography is quoted and collected in its appropriate place to assist the student and research worker, and further it epitomizes the available modern knowledge of the subject. Apart from the botanic interest and classification, the ever-increasing appreciation of the medical profession of the importance and frequency of the incidence of these fungous infections in the human subject demands that every dermatologist should read this valuable book.

C. CRAWFORD-JONES.

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# Society and the Institution of Marriage

**The Future of Marriage in Western Civilisation**

By Dr. Edward Westermarck. Pp. xiv +281. (London: Macmillan and Co., Ltd., 1936.) 12*s*. 6*d*. net.

PROF. WESTERMARCK has applied his world-wide knowledge of the institution of marriage and his life-long experience in analysing its various forms and manifestations to the practical question of the present position and the future of marriage in modern Western civilization—a question indeed which has been much discussed of late years, but at present, momentarily perhaps, seems less insistent. He examines the question here from all sides. Its defects, real or alleged, and the suggested remedies are taken seriatim and discussed with a broad-minded tolerance befitting the impartial attitude of the man of science and the philosopher. This is a point which it is not otiose to make, as Prof. Westermarck has been accused by some of his critics of a bias which makes the monogamous marriage the touchstone of his conclusions as the ultimate and highest development of the institution—in other words, that his arguments have an ethical rather than a scientific background.

History, we are often told, repeats itself. It is interesting to note that whatever the problem under consideration, whatever the remedy which has been tried or is being discussed, Prof. Westermarck has an apposite parallel to cite from the vast store of his knowledge of primitive, barbarian or extra-European culture and from all time. Yet with all this wealth of detail at his command, no mechanical citation of parallels, as he explains in summing up his thesis, has been allowed to offer a speciously facile solution of the problem. He probes more deeply, seeking the underlying causes, that is, the emotional urges which, persistent and perennial, have moulded and will continue to mould the union of the sexes in their chief function, that is, the continuance of the species.

In other words, Prof. Westermarck believes the continued existence of the monogamous marriage as an institution, whatever subsidiary relaxations may be admitted for more aberrant or special needs, is assured as the permanent, and in the long run predominant, form of union. This depends mainly, if not completely, upon its function as the bond of the family, into which children are born and in which they are reared—this only, however, while there is no change in the fundamental urges of human nature as they have existed and persisted up to the present day.

To some it may seem that this conclusion begs the question and leaves the problem unresolved. To Prof. Westermarck, with his world-wide outlook, however, present discontents are but as transient ripples on the pool.

**Foundations of Physics**

By Prof. R. B. Lindsay and Prof. H. Margenau. Pp. xiv+537. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 22*s*. 6*d*. net.

THERE is a type of theoretical physics which consists in the mechanical use of mathematical apparatus; it is to be met with at all stages. The intermediate student develops a fatal facility in the handling of $1/v + 1/u = 1/f$, knowing little and caring less about the physics that is involved. Later, his theoretical physics is summed up in certain differential equations of the second order and, arrived at the boundaries of his subject, we may see him later still employing the most recent technique in matrix theory and in vector algebra, finding in this technique an instrument for saving, rather than for stimulating, thought.

The authors of this most valuable volume by no means despise mathematical aids, but mathematics is always the servant, and there is no danger of losing the physical argument in a maze of mechanically handled mathematical symbols. The book is a real study of the foundations of physics, and whether the authors are engaged in the exposition of the bases of classical mechanics, or in explaining the statistical point of view, the electron theory and special relativity, or the latest developments in quantum mechanics, they are clear, critical and stimulating.

It is not too much to say that the book is one of the best attempts that have yet been made to survey the foundations of modern physics in a manner at once thorough and yet not over-detailed. It may be unreservedly commended to the notice of students in the honours schools of physical science. A. F.

**Logic in Theory and Practice**

By Prof. C. G. Shaw. Pp. xvii+428. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 8*s*. 6*d*. net.

AN additional text-book of logic will not necessarily improve the "low ranking in popularity" of that subject. Yet, Prof. Shaw has written one with the object of trying to make logic "as vital and interesting as its frigid forms will permit". It is difficult to say whether the author has succeeded in this undertaking, as the response has to come from the student rather than from the teacher. But in so far as the latter is concerned, he will find little in this new book to justify its substitution for other similar works. A point in its favour is the fact that the author tries to be more human in his exposition of the traditional theories: his treatment of the logic of judgment and of the hypothetical syllogism are good illustrations of this characteristic. But on the other hand, there are many points of scientific method which he has deliberately overlooked, though they have their place in the scheme of the inductive process. The additional chapters of the theory of knowledge are not at all out of process, though they raise more problems than they can attempt to solve. The writing and the production of the book show, nevertheless, that logic still has a good following and that it deserves a still greater one. T. G.

**Das Grosse Moos im westschweizerischen Seelande und die Geschichte seiner Entstehung**

Von Werner Lüdi. (Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich, Heft 11.) Pp. 344+13 plates. (Bern: Hans Huber, 1935.) 19.80 francs.

"DAS GROSSE MOOS" is the name of the extensive plain lying between the lakes of Neuenburg (Neuchâtel), Bieler (Bienne) and Murten (Morat) in western Switzerland at the foot of the Jura range. The area has been subjected to considerable floodings, to remedy which artificial drainage on a considerable scale has been undertaken and has led to the lowering of the water-level in all the lakes and an increase in cultivated land. The volume under notice includes a very full account of the existing ecology and of the history of the area.

By a combination of methods, it is shown that there have been considerable fluctuations in water-level in the lakes, and the surrounding area, during post-glacial times. These fluctuations have been mapped mainly by the construction of pollen-diagrams, based on the examination of samples from the peat deposits, and on the correlation of the variations in pollen content with archæological and geological evidence and comparison with similar results obtained in other parts of Europe.

The work is essentially a very careful and detailed account of the influence of post-glacial climatic changes, working especially through erosion, and of man, on the topography and vegetation of a limited area in Central Europe. As such it is a valuable contribution to the accumulating knowledge of the history of European plant-life. W. B. T.

**A Documentary History of Primitivism and Related Ideas**

Vol. 1: Primitivism and Related Ideas in Antiquity. By Arthur O. Lovejoy and George Boas: with Supplementary Essays by W. F. Albright and P. E. Dumont. Pp. xv+482. (Baltimore: The Johns Hopkins Press; London: Oxford University Press, 1935.) 22*s*. 6*d*. net.

THIS imposing undertaking, of which the first volume is under review, proposes to give direct evidence of the views held throughout Western civilization on primitivism and related ideas. Its chief interest lies in the compilation and classification of the various quotations selected by the authors; so that it is really with a source book about the conceptions of Nature as shown through the ages that we are concerned. This first volume deals with the Greek and Roman authors, of which it gives several and large extracts. Though there is little to say about the extracts themselves, it may be pointed out that half of the labour done is of little value, for each extract is followed by a translation. The latter alone would have been sufficient.

The publication of the book, which is bound to have a limited appeal, is, however, symptomatic. For it gives an encouraging background to the advanced views about the individual and society, which are held and defended in some quarters.

# The Progress of Man*

THE necessity of considering a number of controversial topics can be avoided by omitting to define the term progress, but it is generally agreed that progress, like degeneration, involves change, and while progress leads upward from a starting point, degeneration takes a downward course.

The material needs and aims of man claim first attention of a technologist. They may be grouped in a relatively small number of 'types of satisfactions'. Each of these has acquired in course of time a greater and greater variety, and a more and more involved technique of means of fulfilment, comprised in part of methods and natural materials, in part of artefacts, in varied combinations. We do not perhaps estimate the level of a culture by the nature and multiplicity of its aims; but it must be recognized that progress has depended on proliferation of aims, as much as on the multiplication of means. It might gratify our self-esteem if we could think that man's progress was determined by persistence in his aims; but this is only true of civilized communities, in which directional investigation has transformed the quest of means by inflation of the aims.

Much importance must be attached to man's attitude towards the possibility of progress in a general sense; and it is necessary to emphasize the fact that the idea is not inherent in the human mind. It is a conception of future possibilities, developed from the study of past actualities, and adopted as a framework of modern thought. We are justified in assuming that, to the early discoverers and inventors, the general idea of progress was lacking. It may be justifiably asked, however, whether the lack of a general idea of progress must be fatal to progressive steps in human culture. Since man had made great material advances long before the idea was formulated, it is clear that these were not due to perseverance in an aim that he had set before himself. As in so many spheres of human thought, theory followed practice.

That the natural environment plays an influential part in the early stages of cultural progress is obvious enough. Only in proportion as the natural environment is swamped by the artificial, does man acquire a freedom which enables him to overcome the limitations of his habitat. His success in this direction has at various periods resulted in a cultural momentum, which has taken him far from his starting point. In spite of the fact that the achievement of a high material equipment, and even a domineering empire, has often been succeeded by a crash, there has always been a continuity in many cultural elements, upon which further progress could be based. The cultivation of plants, the domestication of animals, the working of iron, and much else, once learnt, have never been forgotten, and there has, therefore, been a fluctuating continuity in human progress. But although there has been this continuity in important elements of culture, there are many instances in which its absence is conspicuous. There have been numerous false starts, numerous blind ends in human progress.

Observation and applied discoveries arise out of the opportunism that takes advantage of the accident which reveals a possibility. Here we must postulate a limited amount of foresight, leading to an adaptation or combination of known processes and methods to produce a new result. But it is the habit of the discoverer and inventor to proceed along any line that gives immediate results, and he is unable to choose the route of greatest promise. The human mind has seemed to wander without guidance—though usually in the end arriving somewhere—amongst the many possibilities of discovery and invention, striking into paths that ended blindly, returning to an old starting point, creating spurious needs and multiplying superfluities, and, in general, moving forwards, backwards, or sideways in or out of control, without knowing what its destination might turn out to be.

If material progress has been of this nature, it is clear that social progress, whether in the higher or the lower grades of culture, has had no better guidance. The customs and laws of human communities are the objective, though immaterial, products of the human mind, reacting through the ages to the stresses and strains of the environment, natural and artificial. They are comparable with the more substantial products of discovery and invention. In both, there has been an evolution, which has trespassed far beyond the biological necessities, and we are entitled to inquire whether the mind of man has been moulded in response to, and in correlation with, the exuberance of his egoistic culture. It is often said that "human nature doesn't change". Does it, or doesn't it? If it does not, can it?

The conception of the nature of human progress, here set forth, makes no allowance for an expansion

* Substance of the presidential address entitled "Concerning Human Progress" delivered by Dr. H. S. Harrison before the Royal Anthropological Institute on June 30.

of man's inherited capacity for taking pains successfully. The assumption has been made that ancient man and modern man are on the average essentially alike in potential brain-power. It might seem that the remarkable control over natural materials and forces, with the resulting creation of miracles of mechanism, is evidence that modern civilized man must be born with faculties of a higher order than those of the early representatives of *Homo sapiens*. But most of our 'miracles' are the products of the last few hundred years, and the more spectacular have emerged within the present century. In the time of Queen Elizabeth, the civilization of Europe could boast of little that was much beyond the material achievements of the old civilizations of the Near East. It can scarcely be asserted that the brain of a modern Englishman is of better quality than that of an Elizabethan. Since early times, there have been no processes of artificial selection, no eugenic measures, that can have aided in fostering types with better brains. If anything, the methods of civilization often appear to have the opposite result.

The earliest and first type of *Homo sapiens* to appear on the spade of the archæologist is Aurignacian man, and the proposition may be argued that his physical likeness to ourselves was not accompanied by any innate and fundamental dissimilarity in brain-power. In the evolution of his material culture, man still relies upon the faculties that served his prehistoric ancestors, and if we feel less confident in making the same assumption as regards his innate moral and intellectual qualities, we need only look upon the stage of large parts of Europe and Africa to-day to realize that the experience and wisdom of millennia have failed to establish the brotherhood of man on a reciprocal basis.

If modern man, as compared with ancient man, has undergone a change of heart and mind, we are entitled to inquire by what biological compulsion this has come about. Since the human mind has determined human progress, we must consider whether those factors which are believed by some biologists to have been active in organic evolution in general can have been working on the human brain during the time that has elapsed since *Homo sapiens* first and finally became the man of modern type.

Of the various factors which have been suggested as responsible for the production of the highest type of tailless ape, natural selection, orthogenesis and use-inheritance alone concern us, as it is directional factors we seek. Yet of these it can be shown that, however much modern man may owe to natural selection for his neanthropic characters, since the directions in which it may have acted as regards man's intellectual and moral qualities are those determined by his artificial social conditions, the selection can scarcely be regarded as natural. We may admit that intracommunal selection, even in civilized societies, may foster the development of some qualities at the expense of others; but it is not evident that these qualities are such as can play a part in piloting man's progress along successful lines.

In like manner, if the increase in the size of the brain of mammals were due to an inexplicable momentum, which is imperfectly explained as orthogenesis—an inner urge towards a predetermined end—we cannot assume that the process has led, or will lead, to the production of human minds capable of distinguishing the side-tracks of moral and social progress from the highways. We cannot credit orthogenesis with the power of directing the social organism to a predetermined and desirable end.

Lastly, the factor which, if it could be shown to have been effective, would explain much of the past, and would open up a prospect for the future, namely, use-inheritance, is so strongly repudiated by most biologists that it can only have a speculative value. This is unfortunate, as an easy way to explain the origin of the modern type of man would be by acceptance of the view that both brain and hand were guided to the climax of their neanthropic powers by the summation of inherited ability, increasing through the generations. But if we accept the biological repudiation of this theory, it cannot be applied to man. In any event, we must be prepared to admit that in size and general structure the brain of man appears to have been at a standstill since early neanthropic times.

By way of provisional conclusion, it would seem that the progress of man of the species *Homo sapiens* cannot be regarded as resulting from a correlated and progressive change of heart and mind. What he was, he is, and what he is, he will be. As an opportunist, born and bred, he will go on building and re-building an environment for himself, the specifications for which are but little in advance of the construction. He knows what he is doing to-day, but to-morrow is out of sight. The mind of man has little sense of direction, and if it may be said to have an ultimate aim, that aim is too obscure for formulation. In the course of ages, man has coerced many of the forces and products of Nature to his will, but this has been a simple task compared with that upon which he is now more and more insistently engaged—the task of reconciling the fundamental weakness of his mind, and especially his power of foresight, with the social and material complexities in which he has involved himself. His hope is in himself, and not in any speculative prospect of a mental transmutation.

# Low Temperatures and their Industrial Uses

IN connexion with the Very Low Temperatures Exhibition held recently at the Science Museum in South Kensington, a series of lectures was arranged, dealing both with the production of low temperatures, and with the services which low temperature work renders to technology and to pure science.

Several of the lecturers referred to the history of the successive reduction of the various gases to the liquid state, from the time when Faraday classified as 'permanent' those gases which failed to respond to his technique, up to the liquefaction of helium by Kamerlingh Onnes in 1908. Faraday's method was to compress the gas until it liquefied. Two different processes have since been used in the attainment of still lower temperatures. Both were invented in 1877, in which year they were applied to reduce oxygen to the liquid state. One process, due to Cailletet, uses the work done during expansion to liquefy the gas, whilst the other, originated by Pictet, depends on the Joule-Kelvin effect. Cailletet's method was used by Wroblewski and Olszewski in 1885 for the liquefaction of hydrogen, and was developed commercially by Claude for the production of liquid air. It has recently been modified by Simon for hydrogen and by Kapitza for helium. The alternative method, that of the Joule-Thomson effect, was used by Linde and by Hampson for the large-scale production of liquid air, by Dewar about 1896 for liquefying hydrogen in quantity and by Onnes for the liquefaction of helium, which occurs just above 4° K.

The attainment of temperatures below 1° K., that is, the passage to temperatures below that at which helium has a reasonable vapour pressure, is a very recent achievement, although the magnetic process which has since proved successful was suggested so long ago as 1923. In dealing with this subject, Dr. F. Simon pointed out that the conception of entropy as a measure of orderliness gives a simple physical explanation of the new magnetic technique, which has enabled experimenters to reach temperatures of the order of 0·01° K., and is available down to 0·001° K. Beyond this, there will be the possibility of using the nuclear paramagnetism—the magnetism due to the spin of the nuclei of atoms—and even this will not enable us to *reach* absolute zero. This, like the mathematician's infinity, cannot be attained, but can be approached as nearly as may be desired; in fact, as Dr. Simon pointed out, so long as there remain properties which vary with temperature, so long can we continue to use those same properties to reach lower temperatures.

In the domain of very low temperatures, where the vapour pressures of all known materials are quite negligible, the problem of insulating the cooled solid scarcely exists. There is no gas in which conduction or convection can occur, and radiation at these temperatures is extremely slight. So good, in fact, is the insulation, that the difficulty in the early experiments was to cool other bodies by contact with the paramagnetic salt which was used as 'refrigerant'. This is now overcome by making a pellet in which the substance to be cooled is in intimate contact with the cooling medium.

Turning now to the contributions which low temperature research has made, and is still making, to pure science, we must not overlook the fact that its contributions to industry are also contributions to pure science, for any material which is put cheaply on the market may be of value to the academic research worker.

In a more direct way, low temperature investigations are of value to the worker in pure science, in that they permit him to study the properties of matter under the condition where the heat motion of the atoms or molecules is reduced to a minimum, and where consequently these motions offer less of a masking effect to the actual inter-atomic forces. It is thus natural that low temperature work is more closely associated with atomic than with macroscopic physics. The phenomenon of supraconductivity is the example, *par excellence*, of the unexpected results attained in this field. It is now familiar knowledge that at sufficiently low temperatures, most metals lose their electrical resistance, but lately the subject has been pursued in more detail, and it has been found that the resistance is restored if a sufficient magnetic field is applied to the sample. The field necessary for the restoration increases as the temperature is lowered. This effect has, as a matter of fact, received no satisfactory explanation yet. Another case in which low temperature studies led to an advance in pure science was the discovery of krypton and xenon. This was described by Prof. M. W. Travers, who was present when Ramsay first fractionated liquid air and discovered them in it.

Prof. F. A. Lindemann, whose lecture dealt in the main with the theoretical aspects of low temperature research, pointed out that "low temperature" simply means "a temperature at

which the atoms on the average contain very few quanta". It is thus in a sense accidental that the temperatures which we ordinarily think of as very low are so classified. For material in which the natural forces were of a different order, the sizes of the quanta would be different, and so the low temperature region might have been much higher or lower.

Prof. Lindemann also emphasized another important use of low temperature research. Nernst's theorem, or the third law of thermodynamics, states that entropy (that is, disorderliness, or probability of a state) decreases to zero as the temperature approaches the absolute zero of temperature. This gives us, what classical thermodynamics regarded as impossible, an absolute measure of entropy, as opposed to the measurement merely of entropy differences. Now to measure absolute entropy (from which reaction constants in chemical reactions occurring at ordinary or high temperatures can be calculated), we require measurements of the specific heats of materials right down to the point where these vanish, and hence must be able to carry out measurements at extremely low temperatures.

Since these results can be applied to such reactions as the synthetic production of ammonia and the hydrogenation of coal, they clearly impinge on the third heading under which the subject falls to be considered, namely, the practical or technological applications of low temperature research. Thus, the gases in the familiar street signs owe their commercial production to low temperature studies, and even the relatively common gas oxygen is now more frequently obtained by the fractional distillation of liquid air than by any chemical process.

The history of the commercial production of this gas, as outlined in the lecture by Mr. C. G. Bainbridge, makes a fascinating story. The barium oxide process only dates from about 1885, and, seen in the perspective of history, its duty appears to have been to build up a demand for the gas, and to stimulate the development of the associated needs, such as cylinders for its storage. It is interesting to note that the production in 1887 was about 150,000 cubic feet, and that it had risen in four years to 2 million cubic feet per annum. It is now about 8–10 million cubic feet per *week*. Its uses, too, have changed in the short period concerned. At first, it was required mainly for the lime-light, which essentially was a blowpipe, and for medical purposes. Now, the blowpipe, without the lime-light, provides one of the biggest markets, and is used in a vast variety of different industrial processes. With its aid, divers can cut steel as easily under water as it can be cut in the open air. Again, the medical or semi-medical purposes have themselves increased in number; in mine rescue work, in high altitude flying, and still more in stratosphere flights, the gas is essential, as it is in mountain climbing. (It is to be noted that all the Everest expeditions have been equipped with oxygen apparatus.) For all these purposes, the oxygen now manufactured by the liquid air process provides a cheap and easy source, and moreover, the gas so produced is actually purer than that obtained by the earlier methods. It is perhaps worthy of mention that in the factories of large users, it has now become possible to dispense with the need for transporting cylinders, which owing to their bulk and weight add appreciably to the cost of the gas. The oxygen is now distributed by pipe lines, only being evaporated at the point where it is to be utilized.

Turning from the familiar gas oxygen, we find that the fractional distillation of air yields also the so-called 'rare gases', argon, neon, helium, krypton and xenon. The last two are not in industrial use on any appreciable scale, but they have an interest here on account of the fact that they were first discovered, as Prof. Travers mentioned in his lecture, by the examination of the residues of liquid air, most of which had been allowed to evaporate. The other three rare gases were the subject of a lecture by Mr. J. T. Randall. He pointed out that helium has already been used for filling two large airships, and that it has been proposed to use the gas instead of nitrogen in the air supplied to divers. This would have the very great advantage of minimizing the danger of bubbles of gas forming in the blood when the pressure is released, since helium, unlike nitrogen, is not appreciably soluble in the blood. The most widely used gas of this group, however, is argon. Its chief use is in the gas-filled tungsten filament lamp, of which more than 1,000,000,000 are made annually. Its value here is that it lowers the tendency of the filament to evaporate, and so enables it to be run at a much higher temperature. This causes the lamp to require far less "watts per candle" than the older vacuum lamp, despite the conduction of heat through the gas to the glass envelope. The other type of lamp, the gas discharge, also relies on argon to start the discharge, although in many the vapour of mercury is the main agent for carrying the current after the discharge is started. The colours are, of course, dependent on the gas in the tube, and may be modified by the addition of luminescent solids in powder form.

All the industrial applications dealt with so far are indirect, in that the purchaser, though he may benefit from the low-temperature work, does not receive anything cold. The last example, the subject of the lecture by Dr. I. J. Faulkner, is

direct. We have now become accustomed to the use of solid carbon dioxide for the refrigeration on the tricycles in which ice-cream is transported in the big towns. It has, however, many other industrial uses, and as many as 60,000–70,000 tons are now produced per annum in the United States. A surprising fact is that its loss by evaporation is quite moderate, being about 1–2 per cent by weight in 24 hours, on blocks of the ordinary size. It is also interesting to note that the gas itself, which surrounds the solid block, is a poor thermal conductor. This atmosphere of carbon dioxide is very useful when the solid material—'dry ice'—is used for the preservation of meat and fruit, since it prolongs the life of the latter, and tends to inhibit the growth of moulds and bacteria in the former case.

A growing, but less-known, use of 'dry ice' is in the machine shop, where it can be used for shrinking one part on to another, so that after the inner one warms up and expands, the joint is of enormous strength.

Solid carbon dioxide, like liquid oxygen, has removed the necessity for transporting heavy empty cylinders when supplies of the gas are required at a distance. By purchasing a block of 'dry ice', a customer with a suitable pressure vessel can obtain a supply of carbon dioxide gas from a cylinder which need never leave his premises. He simply inserts the block, closes the vessel and allows the carbon dioxide to evaporate. The gas so obtained is much purer than that from which the 'dry ice' was originally made, since the process has many of the features of the chemist's purification process of recrystallization.

Taken together, the seven lectures illustrate in a forceful manner the strides which have been made in the science and art of low temperature production and utilization, and also the interdependence of pure and applied science. The authorities of the Science Museum are to be congratulated on the provision of the course, which must have added very considerably to the interest of the Very Low Temperatures Exhibition itself, valuable though it would have been without them.

J. H. A.

# Obituary

## Sir William Hamer

By the death on July 7 of Sir William Heaton Hamer, at the age of seventy-four years, epidemiology has been deprived of one of its most zealous students.

William Hamer (he was knighted in 1923) was a scholar of Christ's College, Cambridge, and graduated twelfth wrangler in 1882. After graduating in medicine, he entered the Medical Department of the London County Council and rose to be Medical Officer in 1911, retiring in 1925.

Hamer's mathematical training showed itself in some of his earlier researches, particularly his elucidation of the periodicity of measles in London, which he attributed to rhythmic variation in the number of susceptibles in the population. His work on these lines was afterwards extended by the late H. E. Soper and, although it is now held that the phenomenon is not quite so simple as Hamer suggested, there is little doubt that changes in the proportion of susceptibles form an important element of the general problem.

Hamer was an acute critic of popular epidemiological theories, particularly those based upon bacteriological findings, and a sturdy champion of the doctrine of epidemic constitutions, to which he devoted years of study. The "English Hippocrates", Thomas Sydenham, propounded the general doctrine that all forms of acute diseases prevailing at the same time were linked together by common features in consequence of some general, possibly cosmic, influence which he was unable to define. Hamer attempted to bring this rather vague hypothesis into conformity with modern scientific results. It is generally agreed that, in pointing out the chronological relation of prevalences of obscure nervous diseases to pandemics of influenza, and in explaining the nature of such mysterious epidemics as the 'sweats' of the sixteenth century, Hamer made important contributions to knowledge. To most students, however, his later writings were difficult to follow, and he seemed to exaggerate the importance of Sydenham's views. At his best, he was a most stimulating writer, and he continued the scholarly tradition of Charles Creighton, linking modern science to the philosophical outlook of the ancient masters.

## Mr. W. Newbold

The death, on June 24, of William Newbold, classical scholar, self-taught mathematician, statistician and biologist, at the age of fifty-eight years, just as he was within sight of retirement from his duties as an inspector of secondary schools under the Board of Education, and was wishing for leisure to extend his biological investigations, was a great shock to the large circle of friends to whom he had endeared himself by his ever-ready help and wise and kindly counsel.

Though Newbold never lost his delight in classical and archæological studies, his latent first-rate mathe-

matical ability was, in his early manhood, stimulated by his desire to study astronomy; this led to the mastering of relativity and its application to cosmic theories; statistics next engaged his attention; and his work in this direction was invaluable to his colleagues. His eager avidity for knowledge of all kinds later drew him towards biology: here his love of observation and experimentation found its best outlet, and his work ranged over a wide field of natural history. Drawn by his combined interest in statistics and biology, he bred stick insects, to investigate their rate of increase, over a long period, keeping them in muslin meat safes, until they overflowed his study, his bedroom and his laboratory (a disused windmill). He was particularly interested in small insect parasites, especially those of birds.

The most modest and retiring of men, it never occurred to Newbold to publish any of the curious and interesting observations he made, though they were shared from time to time with his more intimate friends. A man of unusually powerful intellect, of the widest interests and sympathies, there can be no doubt that, with release from routine duties, he would have made valuable contributions to science. He met his end, which he knew for some months to be near at hand, with the utmost calm and fortitude. It is not so much as a potential man of science, but as one of far-seeing and disinterested judgment, whose wisdom in affairs was always freely at the disposal of his friends, that he will be missed.

## Dr. H. J. Hansen

DR. HANS JACOB HANSEN, who died on June 26 at Gjentofte, near Copenhagen, in his eighty-first year, was one of the most distinguished of the long line of descriptive zoologists who have placed the Zoological Museum of Copenhagen in the very front rank of the museums of the world.

Hansen was born at Bellinge in the district of Odense on August 10, 1855, and studied at the University of Copenhagen, where he took the degree of Dr. phil. in 1883 with a thesis on the mouth-parts of Diptera ("Fabrica oris Dipterorum"). While still a student he worked at the Museum under J. M. C. Schiødte and in 1885 he was appointed an assistant in the entomological department, a position which he held until 1910, when in consequence of some changes in the staff he felt compelled to resign. At this time, when the continuance of his scientific work seemed to be in danger, a letter was addressed to him by a large number of zoologists in Great Britain expressing their high appreciation of his researches and their hope that he would be placed in a position to continue them. This letter was published in NATURE on March 10, 1910. Together with the efforts of his scientific friends in Denmark, this led to his being allowed to retire on full pay (although this was small enough, even by Danish standards) "for free scientific activity". He continued to work unremittingly, and letters received from him in the last year of his life were full of work in hand and plans for the future.

Except for an early contribution to the account of Danish fishes in Schiødte's "Zoologica Danica", all Hansen's published works deal with Arthropoda. Within the limits of that vast phylum, however, their range is wider than that attempted by any other zoologist of our time. Insects, Myriopoda, Crustacea, and Arachnida formed the subjects of numerous memoirs and monographs that for fullness and accuracy of detail and for exquisite illustration have never been surpassed.

Hansen's attention was especially attracted by those groups that by reason of their annectent affinities are of crucial importance to the morphologist. Thus he monographed the Arachnid Palpigradi and Podogona (until the other day among the rarest of animals) and the Myriopod Pauropoda and Symphyla; but it was on the Crustacea that the greater part of his work was done. When taking part in the first cruise of the *Ingolf* expedition to the seas of Iceland and Greenland in 1895, he devised a method of sifting the bottom deposits that revealed an astonishing variety of minute Crustacea, and he later published memoirs on the Isopoda and Tanaidacea in which large numbers of new genera and species were established, but the material of many groups still remains undescribed. Even now, little attention has been given to this micro-fauna of the sea-bottom, although it may conceivably play an important part in marine ecology.

Perhaps the most important of Hansen's contributions to morphology was a little paper on the limbs and mouth-parts of Crustacea and insects published in the *Zoologischer Anzeiger* in 1893. This was intended as preliminary to an extensive treatise on the subject which unfortunately never appeared, for when at length he published his "Studies on Arthropoda" in 1921–30, he confined himself to elaborating the details without developing further the broader views sketched in the early paper.

Apart from zoology, Hansen's interests lay mainly in politics and in military history. On these subjects he wrote much in newspapers and magazines, and he published a number of pamphlets mostly with the object of warning his countrymen against the increasing influence of German culture and German politics. He urged Danish science students to look to England rather than to Germany as their 'spiritual home', and was a caustic critic of the "Germanisering af Dansk Videnskab". Nearly all his scientific papers were published in English. In 1902 he was elected a foreign member of the Linnean Society of London.

W. T. CALMAN.

WE regret to announce the following deaths:

Sir Arnold Theiler, K.C.M.G., well known for his work in veterinary research and education in South Africa, on July 24, aged sixty-nine years.

Sir Henry Wellcome, F.R.S., governing director of the Wellcome Foundation, founder of the Wellcome Research Institution, and founder and director of the Wellcome Historical Medical Museum, on July 25, aged eighty-two years.

# News and Views

## Origins of Modern Races of Mankind

SIR ARTHUR KEITH'S presidential address to the first Speleological Conference of the British Speleological Association held at Buxton on July 25 made a bold attempt to resolve a number of doubts and difficulties, which arise out of recent developments in the study of human palæontology. This, Sir Arthur was careful to point out, is a matter relevant to the purpose of the Conference in that discoveries of the remains of ancient types of man in caves have provided a great part of the material, which points to the necessity of recasting the current view that modern races, black, white, brown and yellow, evolved from a common mid-Pleistocene ancestral stock. It will be remembered that it has been demonstrated recently (see NATURE, **137**, 73; 1936) that certain characteristics of the modern Mongolian are to be observed in the remains of Peking man found in the cave of Chou Kou Tien. Sir Arthur would go further. Not only does he too find resemblances to the Mongolian in Peking man, but he also observes Australian and Negro characteristics in *Pithecanthropus* from Java and the Kanam skull from East Africa respectively. From this evidence, therefore, he draws, somewhat tentatively, the conclusion that at the beginning of the Pleistocene, the ancestors of the Mongol, the Australian and the Negro were already in occupation of the continental areas now inhabited by their descendants; and that after their separation each race underwent a series of parallel evolutionary changes in teeth, jaws, brain and other features showing simian affinities.

IN his search for further evidence in support of his hypothesis, Sir Arthur reviewed present knowledge of early man in the areas of distribution of the main divisions of *Homo sapiens*, with the view of showing how far they exhibit traces of this parallel course of evolution. In China, unfortunately, fossil forms of man, which lead on from *Sinanthropus* towards the Chinaman of to-day, have not yet been discovered. For the evolution of the Australian type, he referred to the evidence afforded by Wadjak man from Java, with its resemblance to Talgai man, the earliest known form of Australian, and the fossil remains of Solo man, also from Java. In Africa the geological horizon of Rhodesian man is uncertain, but the Kanam fragmentary jaw from Kenya is not incompatible with the anatomy of Rhodesian man. The Kanjera skulls from deposits of mid-Pleistocene date, or earlier, are the earliest and most primitive form of Negro known to us, while in cave deposits of late Pleistocene date Dr. L. S. B. Leakey discovered fossil remains of a type still existing in north-east Africa. The gap, however, between Rhodesian man and the Kanjera negro still remains. A further problem discussed as needing solution for the acceptance of the theory was the origin of the Caucasian, who does not appear until found in late Pleistocene times as the Cromagnon man of the caves of France and other parts of Europe. For this type, Sir Arthur suggested a possible area of origin in western Asia. It is only when we accept some such view of independent, but parallel, evolution, Sir Arthur concluded, that we can give a coherent explanation of the facts known to us; but it serves only to deepen the mystery of human evolution, for it implies that the future of each race is latent in its genetic constitution. Throughout the Pleistocene period the separated branches of the human family appear to have been unfolding a programme of latent qualities inherited from a common ancestor of an earlier period.

## Historical Memorial in Hatton Garden

AN interesting memorial, the institution of which was organized by Mr. E. Kilburn Scott, was unveiled at St. Andrew's Parochial School, Hatton Garden, on July 25, by the Mayor of Holborn. Much mechanical pioneering started in the district. An early connexion with engineering was in 1804, when Richard Trevithick erected his first steam-carriage in Felton's workshop in Leather Lane. Scientific instrument making began about 1750, when the Italian, F. Pastorelli, began to make thermometers, barometers, etc., the business he founded being still carried on at No. 46. In 1850 Negretti and Zambra joined in similar work, and when the Holborn Viaduct was built, removed to the present site of the Gatehouse, in which Sir Christopher Hatton resided. In 1817, P. Norton Johnson refined platinum and other rare metals in the building No. 79, where similar work is still carried on by the firm he founded. The district has long been famous for watch- and clock-making, and the name of Lund, who made chronometers at No. 4 in 1836, is still well known. St. Geo. Lane-Fox, a pioneer in the making of electric incandescent lamps, was at No. 75 in 1881, and the lamp factory at Hammersmith, built by the Brush Electrical Company to make his lamps in 1888, was eventually taken over by the General Electric Co., Ltd.

THE large building at the corner of Hatton Wall, now partly occupied by Marryat and Scott and by Raphael's, became a centre of pioneer engineering because in the basement there was a boiler and steam engine which supplied power to various tenants. One of these in 1884 was Dr. S. Z. de Ferranti, pioneer of high-tension electric transmission. Another was Sir Hiram Maxim, who developed his first automatic machine-gun in 1889, and he tried it in the basement where Hyde, the engineer, had his power plant. C. F. Cross and E. Bevan, inventors of the viscose process for making rayon fibres from sulphite wood pulp, demonstrated their process in the same building. In the early 'nineties Mr. R. W. Paul, maker of electrical instruments at No. 44, was asked to make kinetoscopes like those of Edison. In 1895 he made a projector to show

the moving pictures on a screen at about the same time that Lumière was showing his in Paris. He gave his first public exhibition in the lecture room of the Finsbury Technical College, where he had formerly been a student. Hatton Garden is associated with Michael Faraday in that he had business relations with Johnson and Matthey of No. 79. Edward Barnard, of the firm occupying No. 54 (the old Court House), was father of Sarah Barnard who married Faraday. Miss Alice Faraday married Fred Barnard, grandson of Ed. Barnard, and a well-known illustrator of Dickens. For a century the district has been famous for skilled craftsmen, makers of optical apparatus, clocks and also of jewellery, etc., including pearls and diamonds. It is now the world centre for the diamond trade.

### Russian Eclipse Measurements on the Ionosphere

WE have received some preliminary results from Prof. W. Kessenich, of Tomsk, U.S.S.R., of the measurements made there on the ionosphere during the total eclipse of June 19, 1936, at the suggestion of Prof. Bonch-Bruevich, and as part of the general scientific eclipse programme of the Russian Academy of Sciences. The main radio work was directed towards the solution of the problem of the source of the ionization of the $F_2$-layer, since earlier eclipses have indicated that the $E$ and $F_1$ layers are mainly ionized by ultra-violet light. The daily variations in the critical frequencies of the ordinary ($f_o$) and extraordinary ($f_e$) rays for the $F_2$ layer were measured, by the pulse method, from June 16 until June 24: in addition, qualitative measurements were made, at a constant frequency, on the absorption changes during the eclipse. The receiving apparatus was in the same room as the transmitter, and included two cathode ray oscillographs, one for visual observation and the other for recording: this arrangement enabled critical frequencies to be measured in one or two minutes with an accuracy of 1 or 2 per cent. The interpretation of the results is unfortunately somewhat limited by the fact that a world-wide magnetic disturbance set in at about three hours before optical totality: this seems in no way connected with the eclipse.

THE observations were made near Tomsk, at a place about 5 km. north of the central line of the optical eclipse, and 4° south of the centre of the corpuscular eclipse (the corpuscular track, for three corpuscular speeds, 800, 1600 and 3200 km./sec., had previously been calculated by A. Michailov). The average critical frequencies observed during the six days were much larger than those for preceding years observed elsewhere; this may be attributed to the influence of the sunspot cycle. The observations show a marked decrease in ionization of the $F_1$ layer during the optical eclipse, suggesting that ultraviolet light is an important part of the source of the ionization; the time of recombination seems to be of the order five minutes, agreeing with the quick appearance and disappearance of absorption at sunrise and sunset observed on preceding and following days. The occurrence of minimum ionization somewhat before totality is regarded as clearly demonstrating the temperature effects suggested by Appleton and Naismith. As regards corpuscular influence, the results are interpreted as indicating that solar particles with velocities of the order 1000–2000 km./sec. play an important part in ionizing the $F_2$ layer, while corpuscles of larger speed are without influence. The stronger eclipse effects observed on June 19, as compared with those found during preceding eclipses, can be ascribed partly to the summer conditions and partly to the increased solar activity in 1936. Taking into account this increased solar activity, and the high level of critical frequencies, which decreased markedly 2½ hours before totality, Prof. Kessenich and his collaborators Baerwald, Bulatov and Denisov are inclined to regard the corpuscular ionizing influences on the $F_2$ layer as established.

### Sale of Newtoniana

As a result of the sale of the Newton Papers, and other articles of interest in connexion with Sir Isaac Newton, by Messrs. Sotheby and Co. on July 13–14, two gifts of scientific importance have now been made possible, and are worthy of record. That portion of the Papers which deal with Newton's work as warden, and afterwards master, of the Royal Mint, is bound in three folio volumes and contains 529 pieces. These were sold for £1,400 to Mr. Gabriel Wells who placed them at the disposal of Lord Wakefield at cost, on the understanding that they would be presented to the nation. Lord Wakefield has presented them to the Royal Mint, where they will be available for inspection. The very valuable and unique collection of Newtoniana already in the possession of the Royal Society has been enhanced by a gift from Sir Robert Hadfield which he purchased at the same sale. The gift comprises the following letters: four from Edmund Halley to Newton: four from Edmund Halley to Thomas Molyneux; two from Fontenelle to Newton; one from Philip Naudé to Newton; and one from Brook Taylor to Newton. A portrait of Sir Isaac Newton, painted in 1702 by Sir Godfrey Kneller (the most famous of the Newton portraits), has been purchased by the Trustees of the National Portrait Gallery (with a contribution of half from the National Art-Collections Fund) from Messrs. Rosenbach, of New York. The portrait was actually sold at the same sale for £800, but through the generosity of Dr. Philip Rosenbach, was re-sold to the Trustees of the Gallery at cost price. Among the many other items of interest in connexion with Newton disposed of at the sale were the following: nine letters to Newton from Edmund Halley, containing the history of the publication of the "Principia" (£310); a note-book in Newton's own handwriting, giving an interesting and amusing list of expenses, and, at the other end, various problems in geometry and conic sections (£180); an autographed draft of about 1,000 words of a very important statement on the invention of the calculus (£210).

### Presentation to M. Marcellin Boule

THE forthcoming retirement of the veteran anthropologist, M. Marcellin Boule, director of the Institut de Paléontologie humaine and professor of palæontology, after fifty years' service in the National Museum of Natural History, Paris, will be marked by the presentation to him of a medal by his friends and pupils as a token of admiration, gratitude and affection. M. Boule has long been recognized not merely as the leading authority in France on early man, but also as one of the very select few among anthropologists at large whose verdict on any matter under argument in prehistoric archæology and human palæontology comes as near finality as is possible in that ever-expanding field of science. Of his numerous contributions to the literature of his subject, "Les Hommes Fossiles" is as widely known as it is authoritative; it will always stand as a record of conclusions based upon profound knowledge and painstaking research. The arrangements for the proposed honour to this distinguished man of science have been in the hands of a committee of which the Abbé Breuil, P. Teilhard de Chardin, Prof. Verneau and other distinguished French anthropologists are members, and on which Great Britain is represented by Sir Arthur Smith Woodward and Prof. W. J. Sollas, Belgium by Prof. C. Fraipont, Holland by Dr. É. Dubois, and Switzerland by Prof. É. Pittard. A replica in bronze of the medal, which is the work of A. de Jaeger, will be presented to each subscriber to the fund, of which the secretaries are MM. J. Cottreau, J. Piveteau, H. Vallois and R. Vaufrey; treasurer, M. Georges Masson. The minimum amount of a contribution is 100 francs; and it should be addressed, 120 boulevard Saint-Germain, Paris (vi[e]).

### Recent Acquisitions at the British Museum (Natural History)

THE Department of Zoology has received as a permanent loan from His Majesty the King a mounted specimen of a cock scarlet-breasted parrakeet (*Neophema splendida*) which was formerly kept as a pet by His late Majesty King George V. This beautifully coloured bird, together with six other members of the same genus, is a native of Australia; it is now very rare, and the Museum possesses only a few examples. Two important collections have been acquired by the Department of Geology. One comprises a large series of Pleistocene and Quaternary mammals, chiefly from Clacton and the Lee Valley, collected over a series of many years by Mr. S. Hazzledine Warren, of Loughton, with special regard to their exact horizon and locality. The other acquisition consists of nearly two hundred type and figured specimens from the collection of Mr. J. W. Tutcher, of Bristol, of Jurassic invertebrate fossils, mostly Liassic ammonites from the Radstock district, described by the late Mr. S. S. Buckman. Mr. F. N. Ashcroft, who has long been a generous donor to the Mineral Department, has presented a further selection from his collection of Swiss minerals. The selection numbers about eighty-four specimens from twenty carefully recorded localities, and forms a valuable addition to the now extensive series of specimens from Switzerland in the Collection. The recent cliff fall between Newton and Yarmouth brought to light the existence in the Isle of Wight of gypsum. Mr. W. White has given the Museum one of the largest crystals that has been found. The most conspicuous of the purchases are a group of well-formed crystals of the beautiful emerald-green copper mineral, dioptase, from the French Congo, a magnificent group of prismatic crystals of celestine, and a large well-crystallized specimen of native copper.

### Prices of Biological Books in 1935

THIS analysis of the cost of biological books in 1935 by John R. Miner (*Quart. Rev. Biol.*, Dec. 1935) is the tenth of its kind, and allows of a comparison between the current prices and those of 1926, as well as between those of 1934 and 1935. The prices are quoted in cents per page and at the current rate of exchange into United States currency. The number of pages reviewed is 143,199, an increase of 15·6 per cent over 1934 and 73·4 per cent over 1926. The cheapest of all publications are those of the U.S. Government, which are only 0·11 cents per page, a truly astounding figure which represents a reduction of 38·9 per cent on 1934 and 64·5 per cent on 1926. The next cheapest are those of the British Government at 0·50 cents per page, a decrease of 43·8 per cent from 1934. It is pointed out that there has been a reduction of 25 per cent in the export price of German publications which, as it occurred late in 1935, does not come into the calculations. Against this is to be set the fact that from 1934 to 1935 there has been an increase of 7·9 per cent. Moreover, over the ten years there has been an increase of 87·2 per cent in the price of these works, so that Germany heads the list with an absolute price of 2·04 cents per page, or nearly twenty times that of the U.S. Government or two and a half times that of British non-Governmental publications. France started the decennium with the low price of 0·35 cents per page, and in spite of a drop of 14 per cent from 1934 has a total increase over the period of 145·7 per cent. The non-Governmental publications of Britain are 0·84 cents per page, of France 0·86 cents per page and of the United States 0·90 cents per page. In considering these statistics, it is to be borne in mind that they are not based upon the whole of the biological books published by the countries chosen but upon such samples as passed through the hands of the reviewer. They are not absolute, therefore, but they may be taken as giving some approximation to the actual conditions.

### National and International Health and Welfare

VOLUNTARY associations providing maternity and child welfare services, under the Local Government Act, 1929, now receive annual contributions from the county or county borough council in whose area or for whose benefit they work. The Minister of Health has accordingly issued a circular (1538) reminding county and county borough councils

outside London that they must prepare schemes in order to secure the payment of annual contributions towards the expenses of such voluntary associations within their areas, copies of model schemes for their use being enclosed with the Circular. Respecting venereal diseases, the Minister of Health has issued circulars (1536 and 1536*a*) to the responsible port and local authorities in England and Wales enclosing a revised list of treatment centres in the chief sea and river ports throughout the world at which seamen can obtain gratuitous treatment for these diseases, in accordance with arrangements contemplated by the international agreement signed at Brussels in 1924.

### The Lister Institute of Preventive Medicine

THE Annual General Meeting of this Institute was held on June 9, and the Governing Body presented the forty-second Annual Report, in which the activities of the Institute are surveyed. Investigations have been carried out upon vaccinia, tumour-exciting, neurotropic and other virus agents by the director, Prof. J. C. G. Ledingham, and Dr. E. W. Hurst, Dr. C. R. Amies and others. Various serological studies are being continued by Dr. A. Felix and collaborators. Dr. V. Korenchevsky is continuing his work on sexual hormones, and Prof. R. Robison with others is studying phosphate metabolism and tissue calcification. Investigations on rheumatism and the possible presence of a virus agent in this disease are being pursued by Dr. Amies and colleagues in conjunction with King's College Hospital. In the Division of Nutrition, much work upon vitamins and dietary constituents has been carried out by Dr. Harriette Chick and her associates. The Svedberg ultra-centrifuge, referred to in last year's Report, with accessory equipment is now in course of installation. At the Serum Department at Elstree, under Dr. G. F. Petrie, to which the Vaccine Department has now been transferred, work on meningococcus and gas-gangrene anti-sera and on staphylococcus toxin is in progress. This brief and incomplete survey illustrates the important research work now being carried on at the Lister Institute.

### Experimental Research and Disease

THE tenth Stephen Paget Memorial Lecture was delivered by Sir Malcolm Watson at the annual general meeting of the Research Defence Society, held at the London School of Hygiene and Tropical Medicine on June 9, the president, Lord Lamington, occupying the chair (The *Fight against Disease*, **24**, No. 3, 1936). In order to illustrate the importance of experimental research, Sir Malcolm surveyed the work of Manson upon elephantiasis and filarial periodicity and malaria, of Ross upon malaria and its transmission by mosquitoes, and of Reed upon yellow fever. By applying the knowledge won by Walter Reed and his American colleagues, the city of Havana was within a few months freed from yellow fever for the first time in a hundred and fifty years by exterminating the mosquitoes that convey the disease. Owing to an increase in member's and life-member's subscriptions for 1935, the Research Defence Society has commenced the current year with a small balance in hand.

### A New Anthropological Publication

A NEW publication of the Section of Anthropology of the Department of the Social Sciences of Yale University, entitled "Yale University Publications in Anthropology", has appeared, which will embody the results of researches in the general field of anthropology directly conducted or otherwise sponsored by this Department of the Graduate School, the Department of Anthropology of the Peabody Museum, and the Department of Anthropology of the Institute of Human Relations (Yale University Press, New Haven, Conn.; London: Oxford University Press). The issues, which will range from brief papers to extensive monographs, will be numbered consecutively as independent contributions, and will appear at irregular intervals. The first issue (Nos. 1-7) includes a study of population changes among the northern Plains Indians by Dr. Clark Wissler, an examination of regional diversity in sorcery in Polynesia by Dr. P. H. Buck, an account of cultural relations of the Gila River and Lower Colorado tribes by Dr. Leslie Spier, with several other communications dealing with aspects of the culture of the Indians of North America. A further issue of the publication, which will comprise six communications, is in the press. In view of the widespread activities in anthropological research of the institutions interested in this publication, and more especially of Yale University, the facilities which it will afford for early publication of results will be of great advantage to anthropologists. In this connexion, it may not be out of place to refer to the announcement that Dr. David G. Mandelbaum of Yale, who has hitherto specialized in the culture of the North American tribes, will be engaged during the coming year in an investigation among the hill tribes of Southern India.

### History of Fire-Fighting in America

IN a paper received from the Smithsonian Institution, a brief history is given of fire-fighting in America from colonial days to the present time. It starts with the days of the 'bucket brigades'. Many of the earliest American communities required property owners to have fire buckets in their houses, which they had to throw into the street when a fire alarm was sounded. They were then picked up by the men who raced to the fire, and when the fire was extinguished these buckets were piled up on the village common, where the owners came to claim them. In an exhibition being held in the National Museum in Washington, many of these buckets are shown. They are made of leather, and in addition to the names of the owners are decorated with family devices and scenes of the time. The first hand-pumped fire engine or tub, made in 1740, is on exhibition; but the bucket brigades were still necessary in order to fill it with water. These tubs were pulled by hand, and at night runners went before them carrying torches or lanterns

on sticks to light the way. Rival companies raced to a fire, and it was a sporting event which of them should be first there. Many incentives were offered to the companies, who sometimes did what they could to slow up their rivals. Cast iron plates were fixed to houses insured by those insurance companies paying bounties to fire-fighters who saved insured property. The fire-fighters were in great demand for parades and political rallies, and no celebration was complete without them. Next came the days of steam fire-engines pulled by horses, and then the motor fire-engine.

### The Blue Water of Crater Lake

IN the Cascade Mountains, Oregon, is the remarkable Crater Lake. It is about six miles long by four miles wide and lies within a volcanic crater the cliffs of which are 500–2,000 ft. high. Its depth in places is nearly 2,000 ft. It has no visible outlet, yet its water is fresh and is said never to freeze, although the surface is about 6,000 ft. above sea-level. It was discovered by white men in 1853, and was called the Deep Blue Lake. Seen from the rim of the crater, the water shades from turquoise blue along the shallow borders to darkest prussian blue in the deeper parts. From a boat, the colour deepens to dark indigo. Cloud shadows and wind flurries produce great variety in the appearance of the surface, but the main sensation produced in the eye of the observer is one of "unbelievable blueness". Dr. Edison Pettit, working on behalf of the National Academy of Sciences and the National Park Services, has recently completed a study of the reason for this extraordinary depth of blue (*News Service Bulletin* (School Edition); Carnegie Institution of Washington, 4, No. 4). He finds that the water has no special colour of its own, but that it is exceptionally free from suspended matter; such scattering of light as occurs in its depths is mainly from the water molecules, and is therefore deep blue. The degree of clarity is almost that of specially prepared dust-free water. The scattered light from dust-free water is blue at all angles; that from Crater Lake water is white only for a comparatively narrow forward angle, and at all other angles is blue.

### Wooden Pipe Lines

THE use of wooden pipes as a means of conveying water dates back almost to prehistoric times. They were much used in the Middle Ages. During recent years, traces of the water supply system of London (*c.* 1600) by means of hollow trunks of trees have often been found during excavations. In *World Power* of May, there is a paper by T. Pausert, telling how wooden pipes made of staves and bound with hoops are coming into modern practice all over the world. Generally, the staves are made of pine or larch wood, and are planed off to give a smooth finish after assembly. The contact surfaces are dove-tailed. When the pipe is filled with water, the wood swells and becomes water-tight. These wooden pipes are either placed on the ground or laid in the open on supports. Their diameters vary from 5 cm. to 6 metres. A great advantage is the immunity of the wood from the effects of water whether it is pure, acid, alkaline, saline or contains selinite. For this reason, wooden pipes are much used in the chemical industry. An important point is that salts are not deposited on the walls of the pipes, so that the latter do not become choked and their rate of flow affected. There is no risk of electrolysis from stray electric currents. If an increased pressure becomes necessary, it is easy to reinforce them by the addition of new steel hoops. If a sudden hydraulic surge occurs, the inherent elasticity acts as a safety valve; the staves being bound by hoops enable the longitudinal joints to let water escape in small jets. When the pressure comes back to normal, the staves resume their original position, and become water-tight again. Their cheapness, durability and the ease with which they can be transported in mountainous regions enable the power engineer to arrive at solutions to many of his problems by their use.

### Safety on the Roads

THE National Safety Congress was held in London on May 20–22. An account of the congress is given in *Roads and Road Construction* of June 1. At the Congress dinner, Sir Herbert Blain pointed out how much the British have learnt from the Americans in connexion with improving our roads and making them safer. In particular, he mentioned the practice of coloured traffic lights and of one-way streets. Although there is a magnificent system of roadways in Great Britain, there are no roads that can compare with some of the roads now being laid in America. These national highways are very wide and have a beautiful surface, good elevation and proper lighting. The curves are properly rounded, and there is no ribbon development. Mr. A. Matheson, the assistant secretary to the Minister of Transport, read a paper on "Danger Spots". Experiments have been carried out in London, where certain roads with black records have been selected. A study of these records showed that a large fraction of the accidents occurred to pedal cyclists and pedestrians. These roads were then inspected and improvements suggested which it is hoped will diminish the number of accidents. In two of the roads where the work recommended has been completed, a record was kept for six months.

In the Chiswick High Road, the number of accidents as compared with the corresponding six months of the preceding year was reduced by 37 per cent, and in the Fulham Palace Road to Putney Bridge the reduction has been from 88 to 48, or nearly 45 per cent. The Oxford County Council, becoming alarmed at the large number of accidents on its roads, made a detailed investigation of them over two years ending July 1934. The investigation showed that nearly one half of the fatal accidents occurred on certain main roads constituting less than six per cent of the total mileage of the county. During the first seventeen weeks after making certain improvements, it was found that, compared with

the corresponding seventeen weeks of the preceding year, the fatalities were reduced 52 per cent and the number of injured 11·6 per cent. In Glasgow it was found that the installation of light signals at certain junctions reduced the number of accidents by about 75 per cent.

**Farmer's Guide to Agricultural Research**

FOR the past ten years, the Royal Agricultural Society of England has issued annual summaries of research work carried out in the leading branches in agriculture. The publication, known as the "Farmer's Guide to Agricultural Research", is now issued as a section of the Society's *Journal*, so that it may be automatically in the hands of all members. A few copies are published separately for private circulation, and a limited number of copies of previous issues (1925–33) are still available. The Society has now published its *Journal* for 1935 (vol. 96). The various sections of the Farmer's Guide are similar to those of the previous year, as are also the authors responsible for them. The remainder of the *Journal* consists of a number of special articles of outstanding interest, reports of the research work carried out under the ægis of the Society, together with a number of official reports. The volume may be obtained from the headquarters of the Society, 16 Bedford Square, London, W.C.1 (price 15*s*.).

**"Index Generalis"**

THE editor of the "Index Generalis", the 1936 issue of which was noticed in NATURE of July 18 (p. 100), asks us to state that new items for inclusion in this reference work are welcomed. They should be in the form in which they are to appear in print, and should be sent to Prof. R. de Montessus de Ballore, directeur de l'Index Generalis, Sorbonne, Paris Vᵉ. No charge is made for insertions, and there is no obligation to purchase the volume. The only stipulations are that the information should be up to date and that it be revised annually on the request of the editor.

**Announcements**

MR. R. COPPOCK, general secretary of the National Federation of Building Trades Operatives, Mr. Richard K. Law, M.P., and Prof. B. A. McSwiney have been appointed members of the Industrial Health Research Board of the Medical Research Council.

PROF. A. MAIGE, professor of botany in the University of Lille, has been elected *Correspondant* of the Section of Botany of the Paris Academy of Sciences, in succession to the late Prof. H. Jumelle, professor of botany in the University of Marseilles.

THE Trustees of the Busk studentship in aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 while flying an experimental aeroplane, have awarded the studentship for the year 1936–7 to Mr. J. W. E. Clarke, Glasgow.

PROF. PAUL UHLENHUTH, director of the Institute of Hygiene at Freiburg i.B., has been nominated a foreign member of the Royal Academy of Sciences of Stockholm in recognition of his outstanding contributions to hygiene and bacteriology.

THE twenty-eighth annual Autumn Meeting of the Institute of Metals will be held in Paris on September 14–18. The fifteenth Autumn Lecture will be delivered in the Grande Salle, Maison de la Chimie on September 14, at 8 p.m., by Prof. P. A. J. Chevenard, who will speak on "The Scientific Organization of Factories". Further information can be obtained from the Secretary, Institute of Metals, 36 Victoria Street, London, S.W.1.

A PROVISIONAL programme has been issued of a General Discussion of the Faraday Society to be held in the Chemistry Theatre, University of Edinburgh, on September 24–26 on "Structure and Molecular Forces in (*a*) Pure Liquids and (*b*) Solutions". The scope of the meeting does not extend to kinetics, which will form the subject of a forthcoming meeting, or to subjects which have been dealt with at recent meetings, such as dipole moments and the theory of strong electrolytes. A general introduction is promised by Prof. J. Kendall. The introductory paper in Section A (Pure Liquids) will be by Prof. F. London (Oxford), and that in Section B (Solutions) by Prof. J. H. Hildebrand (Berkeley, California). As is usual in these discussions, a number of foreign guests have been invited to take part. Particulars of the meeting can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant for abstracting, indexing and proof-reading in the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Aberdeen—The Deputy Director (August 3).

An assistant lecturer and demonstrator in physics in the University of Leeds—The Registrar (August 10).

A lecturer in physiology (Grade II) in the University of Bristol—The Registrar (August 12).

A general inspector of education and research, agricultural and horticultural division of the Ministry of Agriculture and Fisheries—The Secretary, Minister of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (August 12).

A professor of physics (August 31) and an assistant in bacteriology (August 20) in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2.

Structural engineering assistants for the Designs Branch of the Directorate of Fortifications and Works—The Under-Secretary of State (C. 5), The War Office, London, S.W.1.

A physicist or applied mathematician to the British Cotton Industry Research Association—The Director, Shirley Institute, Didsbury, Manchester.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 207.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Preliminary Note on a New Fossil Human Skull from Swanscombe, Kent

IN June 1935, a fossilized human occipital bone was found *in situ* at a depth of 24 ft. below the surface, in the middle gravels of the Thames 100-ft. terrace at Swanscombe, Kent, in association with implements of the Acheulean culture phase. A note on the discovery appeared in NATURE of October 19, 1935, p. 637.

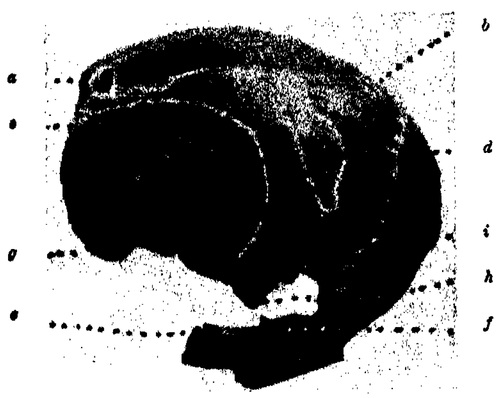


FIG. 1. Left lateral view of the Swanscombe skull.

*a*, Anterior oval depression.
*b*, Posterior round depression.
*c*, Temporal line.
*d*, Muscle attachment above and behind temporal line, perhaps for origin of functional ear muscle.
*e*, Basilar process.
*f*, Foramen magnum, filled with plasticene to support skull.
*g*, Inverted antero-inferior angle of parietal bone.
*h*, Everted postero-inferior angle.
*i*, External occipital protuberance.

In March 1936, at the same depth, and in the same seam of gravel, the left parietal bone of the same skull was discovered, and this was witnessed and photographed while still embedded in the gravels, by an independent observer.

Both of the bones are in a remarkable state of preservation. The occipital bone is unique among the earlier specimens of fossil man in preserving the basilar process, the foramen magnum and the condyles, and both bones are complete in all their margins. They thus furnish the important positions for cranial measurements of the bregma, lambda, asterion, opisthion, inion, pterion and basion, and the completeness of the two bones permits of the most precise measurements being taken without resort to speculation.

In its relation to other fossil types, the Swanscombe skull is to be regarded definitely as a precursor of the Piltdown type. The comparison of the Swanscombe and the Piltdown skulls may be summarized as follows.

(1) The anatomical features of the two skulls points to a definitely more primitive status for the Swanscombe skull than for Piltdown. The features of the Swanscombe are those of a specialized type less advanced than Piltdown but of the same general type, rather than a variant due to either the difference in sex or in age between two individuals of the same contemporaneous type. Both skulls are almost brachycephalic.

The main features in which the Swanscombe shows greater primitiveness are :

(*a*) Lower vault measured by the bregma-opisthion chord. Swanscombe is smaller than the lowest of the three British reconstructions of Piltdown (after Sir Grafton Elliot Smith).

(*b*) Flat ruggedness and non-filled out contours.

(*c*) Lower height and greater outward and downward slope of the parietal vault.

(*d*) The parietal eminence is not developed to the upward and backward position of Piltdown, but occupies the centre of the parietal bone.

(*e*) Lower frontal development at the coronal suture, with greater incurvature of the antero-inferior parietal angle.

(*f*) The parietal bone covers more of the frontal and the temporal regions of the brain than in Piltdown.

(*g*) An extensive obelion depression marks the sagittal border, and two peculiar depressions or pits, an anterior pit above the temporal line near the anterior border, and a posterior pit near the postero-superior angle are present.

FIG. 2. Left lateral view of Swanscombe endocranial cast.

(2) The comparison of the endocranial casts of the two skulls shows a definitely more primitive stage for Swanscombe than for Piltdown.

(*a*) The visual territories on the occipital region extend over the greater part of the cerebral hemispheres covered by the occipital bone. On the left side, the sulcus lunatus crosses the line of the lambdoid suture.

(*b*) In the parietal region, the orbital, frontoparietal and temporal opercula have not approximated at the anterior end of the horizontal limb of the fissure of Sylvius, and a large fossa lateralis measuring about 2·5 cm. from above downwards, and 1·0–2·0 cm. from before backwards is present.

(*c*) The parietal lobule, and the temporal lobe stand out in high relief as exuberant masses of neopallial growth, and the central and the intraparietal sulci occur in primitive form.

(*d*) The Sylvian fissure runs obliquely upwards and backwards.

(*e*) Low development of the parietal association area.

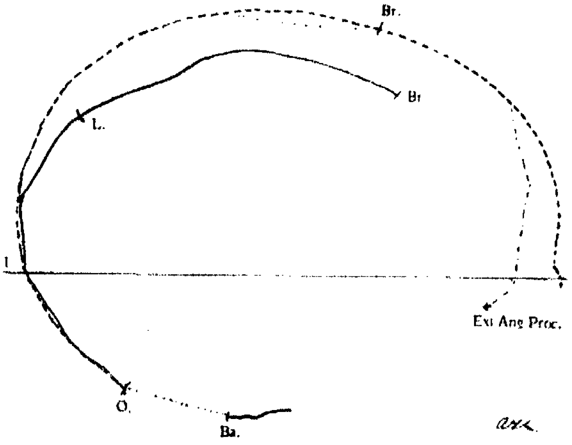


FIG. 3. Sagittal contours of Piltdown (Elliot Smith) and Swanscombe superimposed so that the inion and opisthion coincide. The Piltdown basion does not exist, but the opisthion is represented on the occipital fragment. The difference between the bregma-opisthion chord of the two specimens is not the result of the faulty reconstruction of the Piltdown skull, for if the bones of the two skulls be examined and angulated separately apart from the skull restorations as a whole, the Piltdown bones show an advanced developmental stage over the Swanscombe bones. (Swanscombe: full line. Piltdown: interrupted line.)

(*f*) The distribution of the middle meningeal arteries on the endocranial cast is more primitive in form than Piltdown.

(*g*) The shallow depth from above downwards of the cerebellar fossae is more primitive in form in Swanscombe.

Consideration of the above is sufficient to invite an inquiry into the status of the Piltdown skull. While the geological horizon of Swanscombe as the fossil of the middle gravels of the 100-ft. terrace is authenticated and recognized by the Geological Survey, the Piltdown horizon has been referred to the 80-ft. terrace, the 50-ft. terrace, and the 100-ft. terrace. The presence of the 'eoliths' or of the 'bone implement' is not reliable evidence of a Pliocene or Early Pleistocene status for Piltdown. The acquisition of a brain is a process of slow growth, and the differences between the actual anatomical features of the two skulls overwhelmingly favours the view that the geological horizon of Piltdown should be considered as later than that of the Swanscombe horizon in the middle gravels of the 100-ft. terrace.

The Swanscombe associated implements and flakes have been examined by the Abbé Breuil, who classes them as belonging to the St. Acheul 1 and 3 divisions of his nomenclature. The Swanscombe skull may therefore be referred to the St. Acheul 3 culture phase of Breuil.

The Swanscombe associated fauna is being examined separately by Mr. M. A. C. Hinton.

ALVAN T. MARSTON.

74 South Side,
Clapham Common,
London, S.W.4.

## Mass Equivalent of the Energy in Radioactive Transformations

WITH a spark between a lead electrode and an electrode of palladium or one made of a platinum rhodium alloy, it was found that doubly-charged lead ions were formed, which in the mass-spectrograph gave close doublets with the singly-charged rhodium and palladium ions at 102, 103 and 104. The mass differences were $0\cdot0860 \pm 0\cdot003$ at 104 (Pd), and $0\cdot0861 \pm 0\cdot003$ at 103 (Rh). Although the packing fractions of palladium and rhodium have not been determined directly, they occupy a position on Dr. Aston's curve[1] where the divergence of the atomic mass from an even integer reaches its maximum value of approximately $0\cdot085 \pm 0\cdot005$. Assuming this value as applying to palladium and rhodium, we find a value for the atomic masses of the lead isotopes of $206\cdot00 \pm 0\cdot01$ and $208\cdot00 \pm 0\cdot01$.

It is of interest to deduce the atomic masses to be expected for the lead isotopes from the atomic masses of uranium (238·088) and thorium (232·070) given in a recent letter[1]. In the uranium series of radioactive transformations, eight $\alpha$-rays and six $\beta$-rays are ejected with a total energy of 52 million electron-volts (43 in the $\alpha$-rays, and 9 in the $\beta$-rays). In the thorium series, six $\alpha$-rays, four $\beta$-rays and an energy of $43\cdot3 \times 10^6$ e.v. are emitted. The $\alpha$-rays and total number of electrons lost by the radioactive elements are in the proper number to form neutral helium atoms[2] of a mass 4·0039. If we should neglect the mass equivalent of the energy, we would be led to expect mass values for the lead isotopes of $238\cdot088 - (8 \times 4\cdot0039) = 206\cdot057$ and $232\cdot070 - (6 \times 4\cdot0039) = 208\cdot047$. These are higher than the values deduced above by several times the possible experimental errors, and it is impossible to ascribe the discrepancy to uncertainty in the masses of palladium and rhodium, as it would be necessary to suppose that the masses of those elements diverge from integers by less than half the amount required by Dr. Aston's curve.

We have thus an example of the necessity of allowing for the mass equivalent of the energy emitted. As one million electron volts is closely equivalent to 0·001 mass units, the $52 \times 10^6$ e.v. and $43\cdot3 \times 10^6$ e.v. would reduce the expected mass of uranium lead to 206·005 and that of thorium lead to 208·004, which agree within the experimental error with the values deduced from the observations in the first paragraph. Unfortunately, the precision of the measurements is not yet sufficient to decide whether the maximum energy of the $\beta$-rays ($9 \times 10^6$ e.v. and $6\cdot3 \times 10^6$ e.v.) or the mean energy must be considered, or even whether their energy has a definite mass equivalent.

A. J. DEMPSTER.

University of Chicago.
June 13.

[1] NATURE, 137, 120 (1936).
[2] F. W. Aston, NATURE, 137, 358 (1936).

## Ranges of Particles Emitted in the Disintegration of Boron and Lithium by Slow Neutrons

I HAVE determined the ranges of particles emitted during disintegration of $^{10}B$ and $^{6}Li$ by slow neutrons, using a boron or lithium-coated ionization chamber connected with a Hoffmann electrometer. The ranges were deduced from the position of angles on the curves representing the ionization as a function of the pressure. The chamber filled with air was a brass cylinder of 8 cm. inner diameter and 10 cm. height. In the case of boron, pure finely powdered boron mixed with some water was distributed over the inner walls of the chamber; the density of the layer after evaporation of water was $2 \times 10^{-3}$ gm./cm.$^2$. In the case of lithium, lithium hydroxide made insoluble by heating at a high temperature was spread over the surface in an analogous manner with the same density as before. About 10 millicuries of polonium mixed with beryllium were used as source of neutrons, and the chamber was surrounded with a large cylindrical block of paraffin wax for slowing down the neutrons.

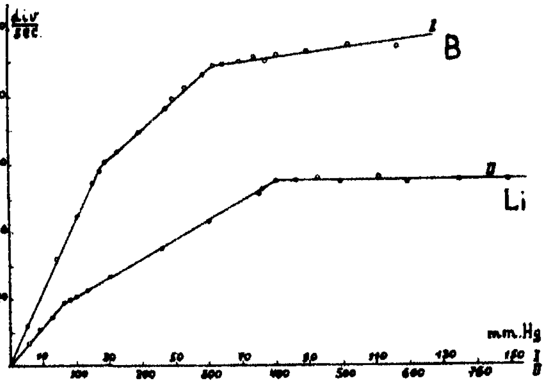


FIG. 1.

In order to evaluate the effect due to slow neutrons, measurements were made at each pressure (*a*) with neutrons filtered through a sheet of cadmium 0·5 mm. thick, (*b*) without cadmium. The difference $b - a$ is due to slow neutrons only.

These differences are plotted against the pressure of air on Fig. 1. The angles corresponding in the case of boron (Curve I) to α-particles and $^{7}Li$ nuclei, and in the case of lithium (Curve II) to α-particles and $^{3}H$ nuclei are well apparent. They occur respectively at the following pressures:

Disintegration of boron: α, 62 mm.; $^{7}Li$, 27·6 mm.
Disintegration of lithium: α, 82 mm.; $^{3}H$, 408 mm.

Owing to the shape of the chamber, the paths of particles *in vacuo* were of unequal length, and it was therefore necessary to define a 'mean effective length of path'. To do this, the apparatus was calibrated in the following way. To the boron powder a few drops of an extremely weak solution of polonium were added, and the substance spread over the walls in exactly the same manner and quantity as before. The ionization pressure curve gave 293 mm. for the position of the angle, which gives 10 cm. as the 'effective mean length of the path' of the particles. Using this value, I obtained the following values for the ranges:

Disintegration of boron: α, 8·18 mm.; $^{7}Li$, 3·64 mm.
Disintegration of lithium: α, 10·8 mm.; $^{3}H$, 53·6 mm.

The ranges for α-particles correspond to the energy $E_{\alpha B} = 1{\cdot}43 \times 10^6$ e.v. and $E_{\alpha Li} = 1{\cdot}93 \times 10^6$ e.v. respectively[1].

Owing to the conservation of quantity of movement, the total kinetic energy of the emitted particles is equal to $\frac{m' + m_\alpha}{m'} \times E_\alpha$, $E_\alpha$ being the energy of the α-particles, $m'$ the mass of the nucleus emitted simultaneously with the α-particles (namely, $^{7}Li$ in the case of boron and $^{3}H$ in the case of lithium). If the disintegration is not followed by any γ-ray emission, this kinetic energy represents the total energy, $E_B$ and $E_{Li}$, released in the nuclear processes under examination. Assuming this to be true, I find $E_B = \frac{11}{7} E_{\alpha B} = 2{\cdot}24 \times 10^6$ e.v., and $E_{Li} = \frac{7}{3} E_{\alpha Li} = 4{\cdot}5 \times 10^6$ e.v.

Using the following atomic masses[2], $n = 1{\cdot}0091$, $^{3}H = 3{\cdot}0171$, $^{4}He = 4{\cdot}0039$, $^{6}Li = 6{\cdot}0167$, $^{7}Li = 7{\cdot}0180$, $^{10}B = 10{\cdot}0161$, I find $E_B = 0{\cdot}0033$ mass units, or $3{\cdot}07 \times 10^6$ e.v., and $E_{Li} = 0{\cdot}0048$ mass units, or $4{\cdot}48 \times 10^6$ e.v. The agreement is excellent in the case of lithium, while in the case of boron the discrepancy is greater than could be attributed to errors in the determinations of ranges. If instead of the experimental velocity-range relation given by Blackett and Lees, we use the numbers calculated from the theories of Bethe and of Bloch[3], then the agreement is in both cases within probable experimental errors. It may also be noticed that Curve I for boron shows a slight increase even at pressures at which the ionization should be constant. This increase may correspond to an unknown mode of release of energy, perhaps related to the existence of γ-rays of boron, reported by Kikuchi, Aoki and Husimi[4].

The cross-section of the boron nucleus for capture of a slow neutron was found to be eight times greater than the cross-section of the lithium nucleus.

My thanks are due to Prof. L. Wertenstein for his interest in this work.

J. ROTBLAT.

Atomic Physics Laboratory,
Free University of Poland,
Warsaw.
June 27.

[1] Blackett and Lees, **134**, 658 (1931).
[2] Oliphant, NATURE, **137**, 396 (1936).
[3] M. Curie, "Radioactivité", tables (1935).
[4] NATURE, **137**, 745 (1936).

## Kikuchi Lines from Etched Copper Crystal

IT is well known that a cross-grating pattern of spots is produced when a fast electron beam is incident, at a small angle, on the etched surface of a single crystal. Two explanations have been given of this phenomenon. Thomson[1] showed that the effect would arise if the electrons passed through small projections on the surface, while Germer[2] attributed it to distortion of the crystal lattice. When etched single crystals of zincblende and galena were studied by Tillman[3], he found Kikuchi lines to be present in addition to the cross-grating and, as has been pointed out previously[4], the presence and sharpness of Kikuchi lines may be taken as a criterion of the degree of perfection of the crystal lattice.

It has been found that an etched single crystal of copper gives Kikuchi lines along with a cross-grating of spots (Fig. 1). The crystal was cut from a freshly prepared single-crystal rod which had been carefully protected from any distortion. Subsequent specimens,

cut from the same rod and etched in the same way, did not give Kikuchi lines, due to the inevitable slight bending of the rod during the first sawing operation. The Kikuchi lines observed were not so

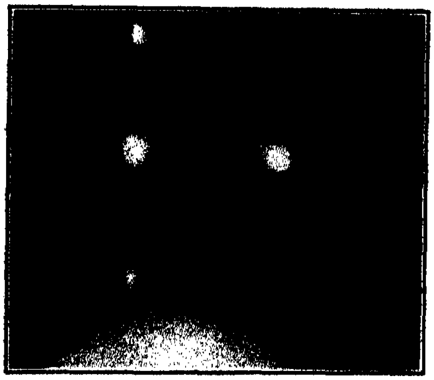

FIG. 1.

sharp as those from zincblende and galena but, nevertheless, they do not indicate a degree of distortion sufficient to allow the formation of a cross-grating pattern in the way suggested by Germer.

WILLIAM COCHRANE.

Department of Physics,
Imperial College of
Science and Technology,
London.
June 18.

[1] G. P. Thomson, *Proc. Roy. Soc.*, A, **133**, 1 (1931).
[2] L. H. Germer, *Phys. Rev.*, **44**, 1012 (1933).
[3] J. R. Tillman, *Phil. Mag.* (7), **18**, 656 (1934).
[4] G. P. Thomson, *Phil. Mag.* (7), **18**, 640 (1934); J. R. Tillman, *loc. cit.*

## Chemistry of Growth Substance B

SOME years ago, we found[1] that a growth substance acting upon *Aspergillus niger* and other moulds was produced when sugars (both pentoses and hexoses) were heated in a solution which also contained some organic acids or salts of these acids. This growth substance only acts when small amounts of ten different metals are added[2]. Also the growth substance produced by moulds or the growth substance extracted from plants, urine, etc., needs these metals to be able to influence the growth of moulds. We called these metals 'co-growth substances'.

TABLE I.

| Added per 50 c.c. | Dry weight in mgm. |
|---|---|
| 1·0 mgm. pyruvic acid | 219 |
| 0·3 mgm. glycolic acid | 167 |
| 1·0 mgm. pyruvic acid + 0·3 mgm. glycolic acid | 348 |
| No addition | 132 |

A continued investigation has shown that this growth substance is produced when sucrose is inverted by means of organic or inorganic acids. For example, a solution of 25 per cent sucrose may be inverted by hydrochloric acid at room temperature. If some of this sugar solution is added to a culture of *Aspergillus niger* after the hydrogen ion concentration has been adjusted, the growth of *Aspergillus* will increase very much. An attempt to purify the active substance is not yet finished; but it has been shown that glycolic acid and pyruvic acid act as growth substances upon *Aspergillus niger*. Glycolic acid or pyruvic acid alone have little or no effect on the growth; but when added together they have a considerable effect.

It is seen from Table 1 that the growth of *Aspergillus niger* is more than doubled by the addition of glycolic acid and pyruvic acid. Some other organic acids also seem to have some influence on the growth. Thus ascorbic acid has a rather large effect when added together with glycolic acid and pyruvic acid, but not alone. Glyoxylic acid seems to have a very strong growth-accelerating influence when added alone or together with the glycolic acid and the pyruvic acid (Table II).

TABLE II.

| Added per 50 c.c. | Dry weight in mgm. |
|---|---|
| 1·0 mgm. pyruvic acid + 0·3 mgm. glycolic acid | 451 |
| 1·0 mgm. pyruvic acid + 0·3 mgm. glycolic acid + 10·0 mgm. glyoxylic acid | 551 |
| 10·0 mgm. glyoxylic acid | 503 |
| No addition | 252 |

The growth substances which act upon *Aspergillus niger* and other moulds are very resistant to oxidation. If a mixture of different plant growth substances is oxidized by means of potassium permanganate or hydrogen peroxide the growth substances which act upon yeast are destroyed, whereas the growth substances acting upon moulds are not destroyed. In this way the two groups of growth substances may be separated.

NIELS NIELSEN.
VAGN HARTELIUS.

Carlsberg Laboratory,
Copenhagen.

[1] *Biochem. Z.*, **256**, 2 (1932).
[2] *Biochem. Z.*, **259**, 340 (1933).

## Relative Velocities of the Absorption of Different Sugars from the Intestine of Rat and Pigeon

THE different velocities, with which various simple sugars are absorbed from the intestine, are among the outstanding facts which demonstrate the active part played by the intestinal mucosa during absorption. Cori[1], for example, finds for the ratio of the absorption velocities of *d*-galactose, *d*-glucose, *d*-fructose, *d*-mannose, *l*-xylose and *l*-arabinose in the rat: 110 : 100 : 43 : 19 : 15 : 9; while Verzár's pupils Wilbrandt and Laszt[2] find 115 : 100 : 44 : 33 : 30 : 29; and McCance and Madders[3] for the ratio of the last two sugars 44 : 25. According to Verzár and his collaborators, the absorption of the hexoses is inhibited by monoiodoacetic acid in contrast with that of the pentoses *l*-xylose and *l*-arabinose, which should not be affected by it. This, combined with the fact that they found equal absorption velocities for these two sugars, leads them to conclude that the absorption process in the case of the pentoses is a simple diffusion from the gut to the blood.

Now, I have shown[4] that the absorption velocities of glucose, galactose and fructose are largely affected by the composition of the diet to which the rats are accustomed, at least when there is only a short fasting period before the beginning of the absorption experiment. There is a real adaptation of the absorption to the presence of these sugars in the diet: the

absorption of glucose is increased by the presence of glucose, fructose or galactose in the diet, compared to a carbohydrate free diet; the absorption of fructose, however, is more specifically stimulated by fructose, the absorption of galactose by galactose in the diet.

From these data several further questions arise. First, has the sequence of absorption velocities, as cited above, a general meaning, or is it more or less a casual product of dietary conditions? Secondly, what are the relative velocities of xylose, and arabinose absorption, those of Verzár and his associates, or those of Cori and those of McCance and Madders? If the latter authors be right, is there really a contrast between the hexoses and xylose as regards monoiodoacetic acid intoxication? Does the ratio of the velocities hold only for the rat, or is it general? Lastly, if it is shown to hold for other animals, at what stage of evolution does it appear first?

I have been carrying out experiments on rats and pigeons which for five days had been on a diet consisting only of fat, casein and salts (no vitamins, as I feared to introduce carbohydrate with the yeast). The rats showed the following series of absorption velocities: *d*-galactose : *d*-glucose : *d*-fructose : *d*-mannose : *l*-xylose : *l*-arabinose = 108 : 100 : 42 : 15 : 13 : 2; the pigeons gave 115 : 100 : 55 : 33 : 33 : 16. Thus there is no essential difference between my results with the rat and Cori's, and also there is no fundamental difference between the rat and the pigeon. Thus the same relationship holds for two species belonging to different, though not quite remote, classes. The smaller differences may easily be explained by differences of technique.

The pigeon showed itself much more sensitive to monoiodoacetic acid than the rat. Doses which did not kill it in two hours did not affect glucose absorption. In the case of the rat, however, not only inhibition of glucose absorption was observed, but also of xylose absorption. I believe that it is quite possible that the inhibitory effect of monoiodoacetic acid is not a direct influence on the metabolism of the intestinal mucosa, as Prof. Verzár thinks, but is a consequence of its disturbing effect on the circulation system.

A full account of my experiments will be given in *Arch. néerl. Physiol.* Experiments with lower animals have been started.

H. G. K. WESTENBRINK.
Lab. voor Physiologische Chemie,
Universiteit van Amsterdam.
July 1.

[1] C. F. Cori, *J. biol. Chem.*, **66**, 691 (1925).
[2] W. Wilbrandt and L. Laszt, *Biochem. Z.*, **259**, 398 (1933).
[3] R. A. McCance and K. Madders, *Biochem. J.*, **24**, 795 (1930).
[4] H. G. K. Westenbrink, *Arch. néerl. Physiol.*, **19**, 563 (1934).

## Several Spontaneous Chromosome Aberrations in *Drosophila*

THE solution of the problem of the phylogeny of the *Drosophila* species requires, in addition to a comparison of the structure of the chromosome in the salivary gland nuclei of related species, also a study of the spontaneous chromosome aberrations. Dubinin, Sokolov, Tiniakov[1] have found a large number of highly concentrated inversions in autosomes in populations of *D. melanogaster* and *D. funebris* taken from different places, but they have found no inversions in the *X*-chromosome, nor no translocations and no deficiencies.

Mass cultures may be compared to a certain extent with populations distributed on a small area, especially when the hatched flies are transferred on to fresh food without being selected. During six months, I studied the salivary gland chromosomes of four *Drosophila* species (*hydei*, *repleta*, *sulcata* and *lugubrina*) taken from such mass cultures. I found six spontaneous aberrations, of which only three were inversions in the autosomes (one in *D. repleta* and two in autosome II of *D. sulcata*). The other three spontaneous aberrations were chromosome rearrangements which have not been discovered in Nature by Dubinin, Sokolov and Tiniakov, namely, a deficiency in an automosome of *D. lugubrina* and two inversions in the *X*-chromosome of *D. sulcata*.

FIG. 1.

A heterozygous deficiency in one automosome limb of *D. lugubrina* (Fig. 1) was detected in about two-thirds of the number of larvæ in one culture; this heterozygous deficiency is retained in mass cultures throughout eight months.

The heterozygous inversions in the two limbs of the *X*-chromosome of *D. sulcata* (Fig. 2) belong, strictly speaking, to two different haploid chromosomes. They occurred independently of each other in two different mass cultures and were retained for several months.

FIG. 2.

In these cultures the females heterozygous for inversions in the right or left limb of the *X*-chromosome were much more numerous than normal ones, and in addition to normal males there were males with an inversion in one of the limbs of the *X*-chromosome. Only owing to the viability of the males with an inversion in the *X*-chromosome could both inversions join in one individual in the case when a chance intermixture of flies from two different mass cultures occurs.

Of course, females with two inversions simultaneously may be only heterozygous. Females homozygous for inversions in one of the limbs are theoretically possible, but in fact they have not been detected either in mass nor in individual cultures. These females are apparently non-viable, this being proved by the numerical predominance of the males in individual cultures, where one of the inversions in the *X*-chromosome has been detected in the larvæ.

Two inversions in both limbs of the second autosome of *D. sulcata* belong to one chromosome because they are always detected simultaneously. No individuals, homozygous for these inversions, have been

found. Chromosome II, heterozygous for both inversions, was found in one of the cultures where both inversions of the $X$-chromosome had been detected. Consequently, in this culture a small number of larvæ with a normal chromosome set and individuals with combinations varying between normal chromosomes and inversions both in the $X$-chromosome and autosome II were observed; which phenomena may also take place in populations in Nature.

S. L. FROLOVA.

Institute of Experimental Biology,
Moscow.
June 21.

[1] NATURE, 137, 1035 (1936).

### The Teaching of Science in Schools

WITH much of what Mr. H. S. Shelton says on the subject of science teaching in schools, in his letter in NATURE of July 18, every teacher will agree. For example, closer association of prominent men of science with secondary education would be welcomed and would be most desirable. It is probable, too, that if another Committee were appointed, similar in constitution to that which sat in 1916–18 under the chairmanship of Sir J. J. Thomson, it would perform valuable service.

Unfortunately, however, Mr. Shelton includes in his letter a number of statements which may mislead those not closely in touch with what is happening. In the first place, it is inaccurate to say that the recent conference on general science represented a belated attempt to implement the (Thomson Committee) recommendation "That the science work . . . should include . . . some study of plant and animal life". The title given to the conference meant what it said and, as a matter of fact, far more schools include biology in their curriculum than Mr. Shelton probably recognizes. Before long, there will be few which do not.

Nor does the sub-committee appointed by the Science Masters' Association to consider the teaching of general science propose (as Mr. Shelton hints) to recommend a time-allowance of three hours per week. On the contrary, its members heartily endorse the original Thomson Committee recommendation that "the time given to science should be *not less* . . . than 6 periods". They would, indeed, prefer a more generous allowance than this.

Facts must, however, be faced: in many schools the recommendation has not been implemented. So that the report might prove useful to teachers in such schools, and so that it might not be merely an academic curiosity, the sub-committee has decided to work out two distinct syllabuses, of which the one to which Mr. Shelton refers is the less important.

When Mr. Shelton writes "If this proposal comes into being, we shall be back again in pre-scientific times", he seems to me guilty of pessimistic exaggeration. By "proposal", I suppose he means the publication of a syllabus, since no one proposes to recommend diminishing the time allowance given to science. It is very unlikely, after all, that the publication of a syllabus—explicitly stated as intended for schools giving a meagre time allowance to science—will encourage the more enlightened headmasters to curtail the time given to the subject in their own schools.

Lastly, I cannot subscribe to Mr. Shelton's statement that "The whole problem of the school time-table is now in hopeless confusion. No attempt is being made, for example, to correlate the mathematics and the science . . ." Confusion is, on the whole, less than it was and in many of the best schools a genuine attempt is being made to achieve some degree of correlation and to act on the recommendations of the various committees which have already considered the matter.

J. A. LAUWERYS.
(Convener of the S.M.A.
General Science Sub-Committee.)

Institute of Education,
University of London.

### Dissociation Energy of Diatomic Sulphur, Selenium and Tellurium Vapours

ON the basis of the spectroscopic data of Naudé and Christy[1], Montgomery and Kassel[2] have recently calculated $F^0$ values for $S_2$ and the dissociation constant for the equilibrium $S_2 \rightleftharpoons 2S$. Their log $K$ values are smaller by nearly 3 units than the experimental data of Nernst and v. Wartenberg[3] at 2290° and 2350° K. Although these latter values may be somewhat erroneous, it seems highly probable that they give the right order of magnitude. The necessary corrections to Montgomery and Kassel's calculations according to the data on vibrational and rotational levels[4] cannot explain this difference.

However, if we assume that the products of predissociation of $S_2$ at $4 \cdot 41 + 0 \cdot 02$ v.[5] (Montgomery and Kassel have used the value 4·45 v.) are $S(^3P) + S(^1D)$ instead of two normal $^3P$ atoms, we get $D_{S_2} = 3 \cdot 28$ v. and the dissociation constant falls within the limit of error of Nernst and v. Wartenberg's measurements.

The dissociation measurements of Nernst and v. Wartenberg allow also of the calculation of the dissociation energy of $Se_2$ and $Te_2$, although the necessary spectroscopic data are not yet sufficient for a high degree of accuracy. The accompanying table summarizes the thermochemical and spectroscopic values of the dissociation energies. In the case of sulphur, the normal state of the molecule is a $^3\Sigma$ state[4], whereas in the case of $Se_2$ and $Te_2$ it is not certain whether it is a $^3\Sigma$ or a $^1\Sigma$ state. In the table, the first value corresponds to the former, the second value to the latter case.

Dissociation energy in electron-volt

| | from spectroscopic data | from equilibrium data at 2350° K. |
|---|---|---|
| $S_2$ | $4 \cdot 41 \pm 0 \cdot 02$ or $3 \cdot 28 \pm 0 \cdot 02$ | 3·2 |
| $Se_2$ | $3 \cdot 1 \pm 0 \cdot 2$[6] | 2·7 or 3·1 |
| $Te_2$ | $2 \cdot 3 \pm 0 \cdot 2$[7] | 2·0 or 2·4 |

With the value $D_{S_2} = 3 \cdot 28$ v., the equilibrium measurements for the three equilibria would be in good agreement; they would also be consistent with the spectroscopic data. If $D_{S_2} = 4 \cdot 41$ v. is correct, however, we would have to assume a very considerable error in Nernst and v. Wartenberg's measurements in the case of $S_2$, although the agreement is satisfactory for $Se_2$ and $Te_2$.

On the other hand, the value $D_{S_2} = 3 \cdot 28$ v. would mean that the dissociation products in the upper level of the main $S_2$-band system are not $^3P + {}^1D$ as in the analogous levels of $O_2$, $Se_2$ and $Te_2$, but probably $^3P + {}^1S$. Although there is spectroscopic

evidence in favour of this solution[6], it is not quite satisfactory.

The two possibilities could be tested by measuring the energy of combustion of the SO molecule, which has been recently isolated by Schenk[8]. For this molecule as well as for $S_2$, two values are possible, $D_{SO} = 5{\cdot}05$ v. and $D_{SO} = 3{\cdot}92$ v., corresponding to the two possible interpretations of the predissociation at 5·05 v. A thermochemical cycle gives for the heat of combustion of SO, for the possible values of $D_{S_2}$ and $D_{SO}$, the values 63, 77, 90 or 104 kcal., so that a measurement of that heat of combustion would give $D_{SO}$ as well as $D_{S_2}$.

*Note added in proof:* In a recent paper[9], Olsson suggests the value 3·6 v. for $D_{S_2}$ on the basis of his experiment on the induced predissociation. His interpretation of the process of induced predissociation is, however, not necessarily correct[6] and the value 3·6 v. does not agree with the attractive character of the $S_2$-level producing predissociation at 4·41 v.

PAUL GOLDFINGER.
WILLIAM JEUNEHOMME.
BORIS ROSEN.

Brussels, Liège and Cointe-Sclessin
(Department of Astrophysics,
University of Liège).

[1] *Phys. Rev.*, **37**, 490 (1931).
[2] *J. Chem. Phys.*, **2**, 417 (1934).
[3] *Z. Elektrochem.*, **9**, 626 (1903); *Z. anorg. Chemie*, **56**, 320 (1908).
[4] Olsson, NATURE, **137**, 745 (1936); *Z. Phys.*, **99**, 114 (1936).
[5] Rosen, Désirant et Duchesne, *Phys. Rev.*, **48**, 916 (1935).
[6] Rosen, *C.R. du Congrès de photoluminescence*, Varsovie 1936. In the press.
[7] Désirant et Minne, *Bull. acad. Roy. Belg.*, **22**, 646 (1936).
[8] Schenk, *Z. anorg. Chem.*, **211**, 150 (1935).
[9] *Z. Phys.*, **100**, 656 (1936).

## Scattering of Light by Light

IN a recent paper[1] Euler and Kockel have calculated the effective cross-section for the scattering of light by light. The calculation was carried out for the case of small frequencies ($\hbar\omega << mc^2$), the frequencies being taken in a frame of reference, where the total momentum of the colliding quanta vanishes.

We have calculated the cross-section for the opposite case of large frequencies ($\hbar\omega >> mc^2$). For the integral cross-section we get an expression of the form:

$$\sigma = a\,\alpha^4\left(\frac{c}{\omega}\right)^2,$$

where $\alpha = \dfrac{e^2}{\hbar c}$ with a constant $a$, which is difficult to compute. According to Euler and Kockel, for small frequencies $\sigma$ is proportional to $\omega^6$. Consequently $\sigma$ has a maximum value in a region $\hbar\omega \sim mc^2$.

It is also difficult to compute the dependence of the differential cross-section on the angle of scattering. We find that for the small angles the polarization of the light quanta is not altered. The differential cross-section for small angles is

$$d\sigma = 8\pi\,\alpha^4\left(\frac{c}{\omega}\right)^2 \log^4\Theta\, d\theta,$$

$\Theta$ being the angle of scattering and $d\theta$ the solid angle. This formula is valid for small angles, but not essentially small compared with $mc^2/\hbar\omega$. In the latter case it is necessary to insert into the logarithm $mc^2/\hbar\omega$ in place of $\Theta$.

The formula has a relative accurateness of $1/\log\Theta$. The cross-section increases with decreasing angles, but not very rapidly, and it is impossible to affirm that this region plays the main role in the integral cross-section.

The detailed calculations will appear elsewhere.

A. AKHIESER.
L. LANDAU.
I. POMERANCHOOK.

Ukrainian Physico-Technical Institute,
Kharkov, U.S.S.R.

[1] *Naturwiss.*, **23**, 246 (1935).

## Mechanism of the Photo-Decomposition of Acetone

IN continuation of an investigation which has been reported elsewhere[1], an attempt was made to produce free methyl radicals by the photo-decomposition of acetone. According to Norrish, Crone and Saltmarsh[2], the radicals are produced by the following mechanism:

$$(CH_3)_2CO + h\nu \rightarrow 2CH_3 + CO$$

which is based on the latter authors' observation that at 60° the main products are equal volumes of carbon monoxide and ethane.

At room temperature, however, we were unable to obtain this equivalence, the volume of ethane being always 1·5 times that of the carbon monoxide. Furthermore, we were able to isolate diacetyl from the liquid products in considerable quantity, determine its boiling point and prepare several derivatives. Diacetyl has previously been detected in the products of photo-decomposition of aldehydes and ketones by Barak and Style[3].

Further experiments with filtered light of different intensities and with different concentrations of acetone suggest that the primary photo-chemical process is:

$$(CH_3)_2CO + h\nu \rightarrow CH_3 + CH_3CO.$$

However, when the photolysis is carried out at 60°, approximately equal amounts of carbon monoxide and ethane are formed together with some methane, the acetyl radical evidently being extremely short-lived at this temperature.

A detailed account of the experiments will be given in a forthcoming publication.

R. SPENCE.
W. WILD.

University,
Leeds.
June 16.

[1] *Proc. Leeds Phil. Soc.*, **3**, 141 (1936).
[2] *J. Chem. Soc.*, 1456 (1934).
[3] NATURE, **135**, 307 (1935).

## Proposed Suspension of Rules of Nomenclature in the Case of Bohadsch 1761

THE undersigned invites the attention of the zoological profession to the fact that application has been made to the International Commission on Nomenclature to suspend the Rules in Bohadsch 1761, "De Quibusdam Animalibus Marinis" and its translation 1776, on the ground that the application of the rules in these cases will produce greater confusion than uniformity.

Zoologists interested in this case, for or against suspension, are invited to present their views to the Commission.

C. W. STILES.
(Acting Secretary.)

U.S. National Museum,
Washington, D.C.

### Measurement of River Bores

WITH reference to the note in NATURE of April 25, p. 711, concerning the observations of the bore in the River Trent, may I direct attention to the observations made by the surveyors of Whangpoo Conservancy Board in February 1920 on the famous bore of the Ch'ien Tang River? Apart from general tide readings, special water-levels were observed every ten minutes during the day and every minute for one hour before and after the passing of the bore, at six stations covering a reach of 18½ miles, for two weeks. The maximum height of the vertical face of the bore was 4½ feet, the total rise in that tide being about 16 feet.

Representative figures, diagrams and photographs are given in the publication entitled "Report on the Hydrology of the Hangchow Bay and the Ch'ien Tang Estuary". This is now out of print, but a copy was deposited in the Science Library at South Kensington.

HERBERT CHATLEY.
(Engineer-in-Chief.)

Whangpoo Conservancy Board,
Shanghai.
May 29.

### The Beams Ultracentrifuge

AN ultracentrifuge designed by Beams has been in operation in this laboratory for the past year. From information published[1,2,3,4], we assumed the forces to be of the order of $5 \times 10^5$ times gravity when driven by air at about 80 lb. pressure. On subsequent measurement we find that the maximum force developed is $4 \times 10^6$ times gravity. This is obtained at a speed of 10,000 r.p.s., which is considerably in excess of that obtained by Beams[4] with a similar rotor under the same conditions.

The figures given in cytological papers from this Department therefore require correction.

A paper on the apparatus and methods of measurement is in course of preparation.

W. CUSACK FAHIE.
University College,
Dublin.

RALPH H. J. BROWN.
Trinity College,
Dublin.

[1] Beams, *Rev. Sci. Inst.*, **1**, 667 (1930).
[2] Beams and Weed, *Science*, **74**, 44 (1931).
[3] Beams, Weed, and Pickels, *Science*, **78**, 338 (1933).
[4] Beams and Pickels, *Rev. Sci. Inst.*, **6**, 229 (1935).

## Points from Foregoing Letters

A DESCRIPTION of a new fossil human skull from the middle gravels of the Thames 100 ft. terrace at Swanscombe, Kent, is given by A. T. Marston. Its features are those of a specialized type less advanced than the well-known Piltdown skull. The author considers that the Piltdown skull must be assumed to come from a later geological horizon than the Swanscombe skull.

Values of 206·00 and 208·00 for the mass of lead isotopes are calculated by Prof. A. J. Dempster, by comparison with palladium and rhodium, by means of the mass spectrograph. This is in agreement with the atomic masses to be expected for lead isotopes derived from the radioactive transformation of uranium (238·088) and thorium (232·070), allowing for the loss of mass due to the emission of alpha-rays (helium) and beta-rays (electrons), and also for the mass equivalent of the energy of the emitted particles.

Graphs showing the ranges of particles emitted by boron and lithium (due to the capture of slow neutrons only) at different air pressures are submitted by J. Rotblat. Taking into account the most probable values of the masses of the particles involved in the transformation, the author finds in the case of lithium good agreement with the total energy calculated ($4 \cdot 5 \times 10^6$ e.v.). In the case of boron good agreement is obtained if the velocity-range calculated from the theories of Bethe and of Bloch is substituted for the experimental velocity-range relation given by Blackett and Lees. The boron curve indicates that there is an additional release of energy from boron, probably in the form of gamma-rays.

When a fast electron beam is diffracted by an etched surface of a single crystal of copper, Dr. W. Cochrane finds, in addition to the cross-grating pattern, also the 'Kikuchi' light and dark line pattern, which indicates a high degree of perfection in the crystal.

Data indicating the growth-promoting action of glycolic, pyruvic and glyoxylic acids upon the mould, *Aspergillus niger*, are given by N. Nielsen and V. Hartelius, in continuation of their investigation on the nature of the growth substance produced when cane sugar is inverted by means of acids.

Dr. H. G. K. Westenbrink shows that fundamentally the same ratio holds for the velocities of intestinal absorption of certain sugars (*d*-galactose, *d*-glucose, *d*-fructose, *d*-mannose, *l*-xylose and *l*-arabinose) with the rat and the pigeon. With both rat and pigeon there is a distinct difference between the velocities of absorption of *l*-xylose and *l*-arabinose.

Dr. S. L. Frolova describes and illustrates spontaneous aberrations of the chromosomes in mass cultures of several species of the fruit-fly, *Drosophila*. Of six changes observed, three were inversions in the autosomes of *Drosophila repleta* and *D. sulcata* and the other three consisted of a deficiency in an autosome of *D. lugubrina* and two inversions in the X-chromosome of *D. sulcata*.

A table summarizing the values of the dissociation energies of the sulphur, selenium and tellurium molecules, as deduced from both spectroscopic and thermochemical observations, is given by P. Goldfinger, W. Jeunehomme and B. Rosen. The authors state that a determination of the heat of combustion of the recently isolated sulphur monoxide would enable a choice to be made between the alternate values deduced from spectroscopic data.

A. Akhieser, L. Landau and I. Pomeranchook have calculated the cross-section for the scattering of light quanta by light quanta for the case of large frequencies.

# Research Items

## Early Man in New Mexico

In view of the discovery by Mr. E. B. Howard of stone artefacts attributed to Folsom man in association with the fossil remains of extinct mammals in what he termed "blow-outs" near Clovis, New Mexico, it is essential for chronological purposes that the geological character of these formations and the conditions in which the remains and artefacts were deposited should be clearly understood. This question was investigated by Messrs. Chester D. Stock and Frances D. Bode of the California Institute of Technology (*Proc. Acad. Nat. Sciences, Philadelphia*, 88, 1936). The "basins"—a term preferable to either "blow-out" or "lake", which are misleading—are depressions, usually several hundred feet in diameter and two to ten feet in depth, in a long shallow trough, the Black Water Draw, from five to ten miles wide, which originates some thirty miles south-west of Clovis. The basins have been formed by wind-action, which has scoured the soil and underlying sediments of the centre, piling it up as sand dunes on the periphery, down to the Blue Sand (a blue-grey sandstone), which forms a smooth flat unbroken floor. As the Blue Sand is cut away—in the centre to a depth of four or five feet—flat benches with steep vertical banks develop. Residual areas capped by Blue Sand are left standing on the floor like islands. Erosion does not proceed beyond the Blue Sand. Probably the Blue Sand underlies the entire floor of Black Water Draw near Clovis. Masses of broken bones are found weathering out of the Blue Sand. These include bison, horse, elephant and camel. Flint chips are abundant on the floor of every basin, and several types of artefacts are associated with them. Artefacts of the Folsom or Yuma type occur only where the Blue Sand has been dissected. Convincing association with fossil mammal material was demonstrated in at least two basins, the Gravel Pit and Anderson Lake. Charcoal suggests a fire, but not necessarily of human origin, as it may be due to spontaneous combustion. The stratigraphic and physiographic relations of the Blue Sand to the present landscape suggest that it is possible to assign a very recent age to the deposit. It dates back to a pluvial period when the rainfall was greater than it is to-day; but this period does not necessarily fall into Pleistocene times.

## Apparent Transformation of one Virus into Another

There are two inoculable tumour-diseases of rabbits, somewhat similar in appearance, and both caused by ultra-microscopic filterable viruses. One, rabbit myxoma, is malignant and always fatal; the other, rabbit fibroma, is never fatal and ultimately ends in recovery. A curious fact recently observed is that animals that have recovered from an attack of fibroma are unsusceptible to myxoma, and cannot be inoculated with it. According to Science Service, Dr. George Berry has reported at the meeting of the American Association for the Advancement of Science at Rochester, N.Y., that when active fibroma virus is mixed with myxoma virus killed by heating and the mixture injected into rabbits, the animals develop the deadly myxoma and die. That is to say, the benign fibroma virus by admixture with dead myxoma virus is apparently transformed into the myxoma virus. Controls with the dead myxoma virus alone had no effect. Further details respecting this important observation, which has been repeated many times, will be awaited with interest.

## Microbiology of Australian Soils

The results of a study, at different ranges of temperature, of the rate of decomposition of organic matter in soil in relation to the numbers of micro-organisms present are detailed in a recent paper by Mr. H. L. Jensen (*Proc. Linn. Soc. N.S.W.*, 61, 27–55; 1936). The decomposition rate was measured by the carbon dioxide production. In soils to which there had been no addition of organic matter, the carbon dioxide production was generally 100 per cent stronger at 28° than at 15° C., and some 50 per cent stronger at 37° C. than at 28° C. At each temperature, there was a significant correlation between daily yields of carbon dioxide and direct counts of bacteria. Growth of fungi was more extensive in sand soils than in loam soils, but no correlation was found between density of mycelium and yield of carbon dioxide. Decomposition of the soil's own 'humus' seems to be carried out almost entirely by bacteria, the accelerating influence of increasing temperature being due to stimulation of the metabolic activity of the bacteria. In soils to which various undecomposed plant materials (straw, hay, fungal mycelium) had been added, the rate of carbon dioxide production increased steeply with rise of temperature from 5° C. to 37° C. Significant correlations appeared between daily yields of carbon dioxide and densities of mycelium, and also between yields of carbon dioxide and direct counts of bacteria, but not between carbon dioxide yields and plant counts. The efficiency of the organisms decreased rapidly with advancing time. The fungi appeared to be important agents of decomposition during the earlier stages when the most intensive destruction of organic matter takes place. It is suggested that, especially at 28° C., their carbon dioxide production may considerably exceed that of the bacteria; with advancing degree of decomposition they cease to be of importance. The decreasing rate of decomposition of added organic materials, together with the increasing accumulation of microbial substance, seems to offer an explanation for the increasing accumulation of 'humus' with decreasing soil temperature.

## Californian Shrimps of Commerce

Mr. Hugh R. Israel's researches on the commercial shrimps of California are interesting and instructive ("A Contribution Towards the Life Histories of Two Californian Shrimps, *Crago franciscorum* (Stimpson) and *Crago nigricauda* (Stimpson)", Division of Fish and Game of California. Bureau of Commercial Fisheries. Fish Bull., No. 46, 1936). Both species move towards the ocean as the spawning season approaches, and the eggs hatch in water of high salinity, the young shrimps migrating farther inshore into less saline water, and as they grow larger gradually moving into deeper water. Both species breed at the end of their first year, and soon afterwards disappear from the commercial catch, the main

breeding season being December–May or June for *Crago franciscorum* and April–September for *C. nigricauda*. A very large catch of *C. franciscorum* in 1932 was made after the breeding season had ended, and one of *C. nigricauda* corresponded exactly with the breeding season. It is suggested that as in May and June 1933 the expected increase of this species did not occur, the heavy inroads made during the spawning season of the year before may be responsible. Very little is known about the planktonic larval stages of their shrimps, although it is presumed that they are similar to those of *C. vulgaris*. The latter species, however, may breed close inshore, and it would be useful to make a careful survey of the larvæ of these two Californian shrimps. The post-larval stages are taken at a considerable distance from the ocean in the shallow water of tidal flats and shoals.

### Cercospora Leaf-Spot of Tobacco

A DISEASE of tobacco caused by the fungus *Cercospora nicotianæ* has attained severe proportions in the tropical areas of Queensland, Australia, the Dutch East Indies, Rhodesia and Nyasaland. The organism may produce spots upon leaves of the host at any stage of growth, and if it occurs in epidemic form shortly before the harvest, it results in a very destructive 'barn spot' during the process of curing. Mr. A. V. Hill has made a thorough study of the disease (*Bull.* **98**, Coun. Sci. and Ind. Res., Australia, Melbourne, 1936), and shows that it can attack twelve species of *Nicotiana*, in addition to the thorn apple and *Nicandra physaloides*. The optimum temperature for growth of the fungus is 26° C., and outdoor temperatures of this order, combined with rainy periods, greatly aggravate the effects of the malady. Seed from infected capsules is capable of transmitting the disease to a subsequent crop grown from it, and the main control measure lies in the use of healthy seed. Many other aspects of the problem are discussed in the paper, which has also seven excellent plates illustrating symptoms and the causal organism.

### The Angiospermic Carpel

DR. I. V. NEWMAN has published (*Proc. Linn. Soc. N.S.W.*, **61**, 56–88; 1936) details of his studies of the floral apex of *Acacia longifolia* and *A. suaveolens*, which have induced him to champion the old theory of the origin of the carpel, and to criticize theories advanced in recent years by a number of investigators. After discussion of the evidence he concludes that (i) the legume is a lateral structure, (ii) the legume is a single, folded structure, (iii) the legume is not a foliar structure; and considers that in the two species dealt with there is no reason for doubting that the legume is of foliar nature and that it is reasonable to interpret the flowers of these species as modified leafy shoots. The subject has recently been under notice in the columns of NATURE (**137**, Jan. 11; March 14, 1936).

### Lunar Periodicity of Earthquakes

OF the three laws that Perrey stated as governing the lunar frequency of earthquakes, the third, according to which earthquakes are more frequent when the moon is near the meridian than when it is at a distance of 90° from it, has suffered most from recent criticism. Mr. M. W. Allen (*Bull. Amer. Seis. Soc.*, **26**, 147–157; 1936) urges, however, that this criticism depends on statistics obtained from large areas, and takes no account of the strike or hade of the faults concerned. He has, therefore, considered the earthquakes during about forty-five years that originated within five or ten miles from three great faults in California. The earthquakes were grouped in different intervals of time, and harmonic analysis was applied to the numbers of shocks within lunar hour angles of 30°. Mr. Allen shows that, for the second harmonic alone, that associated with the semi-diurnal lunar effect, does the epoch incline towards constancy. Moreover, the amplitudes of this harmonic are more prominent than the others, ranging about 0·25 and being in some intervals nearly four times as great as that required by Schuster's test. It is thus difficult to escape the conclusion that "the semidiurnal lunar tidal forces have in some manner acted to determine the moment of occurrence of a significant number of the shocks of the region of the San Jacinto, Agua Caliente, and Elsinore faults".

### Cosmic Rays

THE July issue of the *Journal of the Franklin Institute* devotes 81 pages to the report of the work of the Bartol Research Foundation 1934–35, made to the members of the Institute by Dr. W. F. G. Swann, the director of the Foundation. Almost the whole of the work during that period has centred around cosmic rays which have been investigated at ground-level, and at various altitudes up to 4,300 metres in Peru, Panama, Mexico and at stations in the United States up to 45° N. latitude. The 45 figures given enable the general reader to follow with ease the descriptions of the apparatus used and the results obtained. So far as they relate to the variation of the radiation with the latitude of the place of observation and angular distance from the zenith of the point from which they emanate they confirm the results of other observers, and they supply new facts as to the efficiencies of radiations from different directions in producing the secondary effects known as cosmic ray bursts. Dr. Swann concludes that the primary cause of the rays as measured is in the main an electrically charged particle of which the energy and the energy of the radiation measured is absorbed more rapidly when it is small than when it is large by its passage through the atmosphere.

### The Compton Effect

IN the June issue of the *Review of Scientific Instruments*, Prof. E. L. Hill, of the University of Minnesota, reviews the recent work on this effect, and shows that the simple quantum theory of it, hitherto thought adequate, requires revision. That theory gives when a photon impinges on an electron: (1) the angle of deviation of the photon and its change of frequency, (2) the angle of recoil of the electron and its recoil energy, (3) that the three momenta concerned are coplanar and that the angles of deviation and recoil are related in a certain way. While conclusions (1) and (2) have been verified experimentally, the recent work of Dr. R. S. Shankland in Prof. Compton's laboratory has cast doubts on the simultaneous production of a photon deviation and an electron recoil which (3) assumes, and a revision of our corpuscular theories of radiation will be necessary. Dirac (NATURE, **137**, 298; 1936) has expressed the opinion that most of the present quantum mechanics may be retained, but that the quantum theory of the electro-magnetic field will probably have to be sacrificed.

# Flagella Movement

By A. G. Lowndes, Marlborough College

ALTHOUGH flagella movement or propulsion by means of a single flagellum is probably one of the first types of movement which came into existence, the fact remains that comparatively little is known for certainty about its actual mechanics. For example, it has always been a debatable point whether the flagellum is a passive unit mechanically operated by the cell, or an active structure developing partly or wholly its own energy. It is true that Gray[1] has given much evidence in favour of the latter view, but quantitative data are lacking. It has also been maintained in practically all standard text-books, that in all tractella or cases in which the flagellum is attached to the anterior end of the cell or organism, the waves of distortion pass from the tip of the flagellum to its base.

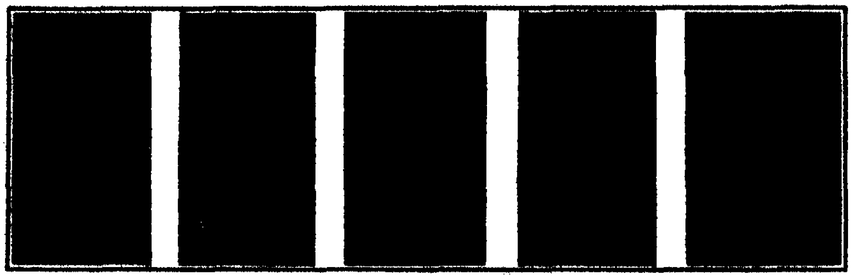

FIG. 1. *Peranema trichophorum.* Five consecutive exposures. Time of exposure, 1/8,000 sec. Interval, 1/80 sec. approx. The wave is clearly passing up the flagellum. The dark spot in the flagellum shows where a slight twisting occurs. This results in the extremity of the flagellum rotating. Measurement shows that the wave passes up the flagellum with an increase in velocity.

By the application of ultra-rapid cinema photomicrography[2] it has been possible to settle the one point and disprove the other. The flagellum is an active unit and generates its own mechanical energy. In the tractella of five species investigated, the waves of distortion start at the base of the flagellum and travel towards the tip.

Fig. 1 shows five consecutive exposures of the flagellum of *Peranema*, which is a very common monoflagellate with a so-called tractellum. The exact interval between the exposures is known, and so is the magnification. The distance from the base of the flagellum to the crest of the wave is easily measured, and on plotting this against the interval, it is established that the wave is passing along the flagellum with a definite increase in velocity.

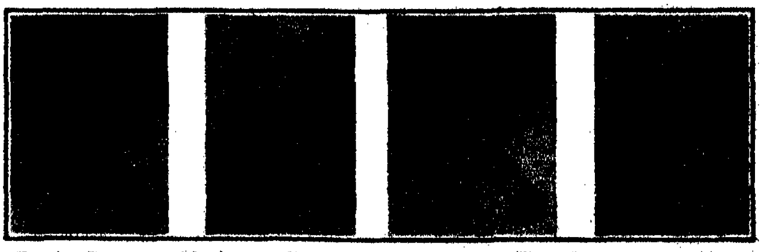

FIG. 2. *Peranema trichophorum.* Four consecutive exposures. Time of exposure, 1/8,000 sec. Interval, 1/60 sec. approx. The wave is passing up the flagellum. The amplitude is increasing as the wave progresses, but it is smaller than in Fig. 1. Two complete waves in the flagellum indicate an increase in frequency.

Fig. 2 shows four consecutive exposures of the flagellum of the same species, but the flagellum is behaving rather differently. Both figures show, however, that a wave passes along the flagellum with an increase in velocity and also an increase in amplitude.

Reference to Fig. 1 also shows that as the wave of distortion passes along a flagellum, a certain amount of rotation of the distal end is caused, and if the energy output of such a flagellum is increased, the amplitude of the waves decreases while the frequency increases and thus a series of small waves is produced. This is illustrated to perfection in *Peranema*, in which the waves pass along the flagellum sufficiently rapidly to cause the tip to rotate rapidly while the proximal part appears to be rather stiffly extended.

The actual tip of the flagellum is bent round so that the impulses passing from base to tip actually produce a forward component, and it is only when the flagellum is extended in this manner that the organism swims forward with its maximum velocity (Fig. 3). The organism itself does not rotate as it progresses, nor does the base of the flagellum.

In *Euglena viridis* the waves of distortion pass along the flagellum as in *Peranema*, but the flagellum is bent right back from the actual base. The waves passing along the flagellum produce both a lateral and a forward component, thus causing the organism to rotate as it moves forward (Fig. 4). The net result is that, as the organism swims forward, its anterior end traverses a circular path at right angles to the long axis of the animal, while the whole of the animal rotates.

Now *Euglena* is highly metabolic, or in other words, it changes its shape rapidly. If the organism approaches or meets anything which normally would compel a reversal or change of direction, the organism immediately swells out at its posterior end and thus causes the anterior end to retract. This causes the flagellum to be swung forward, and the waves passing along it now constitute a powerful backward component, with the result that the organism either swings round with its hinder end acting as a pivot or it may actually swim backwards. When *Euglena* is swimming normally and is rotating, the flagellum appears first on one side and then on the other, and it is, of course, obscured in the intermediate positions.

The rotation may be in a clockwise or anti-clockwise direction.

Altogether five species of monoflagellates have been investigated, and three of them filmed at considerable length. The action of the flagellum in all five species appears to be identical in outline, though quite different in detail.

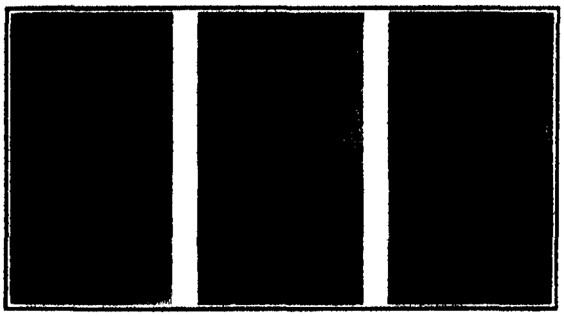

FIG. 3. *Peranema trichophorum*. Three consecutive exposures. Time of exposure, 1/8,000 sec. Interval, 1/30 sec. approx. The waves are confined to the tip of the flagellum. In this case, the organism is swimming forwards with its maximum speed. The extreme tip of the flagellum is not seen since it lies beyond the penetration of the objective.

To sum up: (1) The flagellum generates its own energy, at any rate in part, if not completely. (2) The waves of distortion pass from base to tip of the flagellum and not in the reverse direction. (3) The actual position taken up by the flagellum at any instant will determine whether these waves of distortion constitute a forward or backward component. (4) They may also cause the organism to rotate in a clockwise or anti-clockwise direction. (5) They constitute an important escape movement by causing the organism to reverse its direction

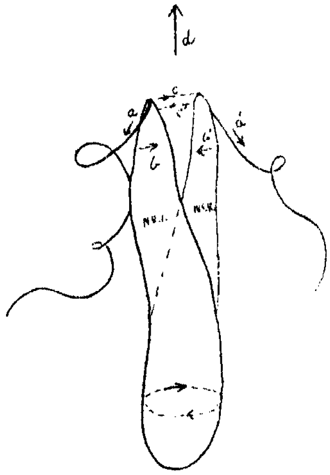

FIG. 4. Diagrammatic representation of *Euglena viridis*.

No. 1. A wave is passing along the flagellum in a direction *a*. This causes the organism to rotate in a clockwise direction *b*. It also causes lateral displacement of the front end of the animal *c*.

No. 2. The flagellum is now on the right of the organism. Either the same wave or another passes along the flagellum. Lateral displacement is in the direction *c'*. The organism is propelled in the direction *d*, and rotates in a clockwise direction. The anterior end moves in a circular path at right angles to the mean direction.

rapidly without necessitating a reversal in either the direction of propagation of the waves themselves or the direction of rotation of the organism.

[1] J. Gray, "A Text-Book of Experimental Cytology". Cambridge University Press. 1931.
[2] A. G. Lowndes, "The Twin Polygraph and Strobograph", NATURE, **135**, 1006 (June 15, 1935).

# Specific Heats of Metals and Alloys at High Temperatures*

AFTER some ten years of experience in the investigation of various physical properties of metals at high temperatures, Prof. F. M. Jaeger and his collaborators at Groningen commenced, about fifteen years ago, the much more difficult investigation of the changes which the specific heats of metallic substances undergo at temperatures up to 1,600° C. At that time there were considerable differences in the data published by various experimenters regarding the specific heats of metals and their temperature coefficients at those high temperatures—differences which could not be accounted for entirely by variations in experimental technique, but which seemed to be due, in part at least, to unknown peculiarities of the metals themselves. As a result of the work of Prof. Jaeger, many of these discrepancies have been removed and much valuable information has been obtained concerning the nature of thermal and molecular transformations in the metallic state.

The direct specific heat measurements were carried out by means of a high-precision metal-block calorimeter in which temperature differences of a few millionths of 1° C. could be measured with certainty. The results obtained by the calorimetric technique were checked and confirmed by independent methods, for example, by measurements of the variation with temperature of the electrical resistance and of the thermo-electric behaviour of the metals. In studying the variation of any such property as a function of temperature, use was also made of two optically coupled galvanometers combined with a photographic recording device in order to obtain continuous curves, which immediately reveal any sudden discontinuity of the variable property at a particular temperature.

As regards the discrepancies in the results of previous workers, Prof. Jaeger's investigations show that these can be largely attributed to the measurements having been made with samples of metal which had undergone different preliminary thermal or mechanical treatment and which, therefore, were physically non-homogeneous due to the presence of inner stresses. Metals which have been suitably tempered by prolonged heating *in vacuo* at a constant high temperature as near to the melting point as possible, followed by slow cooling *in vacuo*, give values of the specific heat which, even at lower temperatures, are quite reproducible. This is especially striking in the case of silver, for which Prof. Jaeger has obtained a $C_p$-temperature curve which is concave to the temperature axis and not convex, as indicated by the best previously recorded data.

In many cases, the behaviour of metals at high temperatures is complicated by the occurrence of allotropy, and the calorimetric method is particularly suited to the detection of such changes. The trans-

* Substance of a lecture by Prof. F. M. Jaeger, University of Groningen, delivered at University College, London, on May 11.

formation to a new allotropic form usually commences at a much lower temperature than the thermodynamically defined transition point, and in this 'transition interval' the specific heat of the metal increases very rapidly with the temperature, often reaching extremely high values.

In passing through the transition point, either by heating or by cooling, the allotropic changes are frequently accompanied by certain retardation phenomena. For example, beryllium, which has been given a preliminary heating at temperatures of 450° C. or more and is then allowed to cool from 400° C., gives off the same amount of heat, but over a longer period, than a sample of the metal which has not been heated above 400° C. The change in the internal state of the metal brought about by the preliminary heating may persist for several months, but there is a continuous return to the original state. Similar changes have been observed with rhodium, zirconium, chromium, titanium, and other metals, and the phenomenon appears to be a very general one. It is interesting to note that in the case of beryllium, the retardation of heat evolution completely disappears if the sample of metal is previously finely powdered.

Another factor of importance is the remarkable influence which may be exerted by almost imperceptible traces of gases—chiefly of oxygen, but occasionally also of nitrogen and of hydrogen—on the phase changes which occur in metals. In the $\alpha$-titanium $\rightleftarrows \beta$-titanium transition, for example, there is at the transition temperature of 882° an additional hysteresis effect, which disappears with a sample of metal prepared *in vacuo*, but returns on the addition of traces of oxygen and nitrogen.

Prof. Jaeger's experimental study of the specific heats of metals at different temperatures has provided more accurate data which can be applied to testing the validity at high temperatures of two important theoretical deductions. According to the quantum-theoretical treatment by Einstein and by Debye of the variation of the specific heat of solid substances with temperature, the atomic heat at constant volume of solid mono-atomic elements should, even at the highest temperatures, never exceed a value of $3R = 5{\cdot}955$ cal. The experimental results make it improbable, however, that any such upper limit exists, since this value is already exceeded in most cases at relatively low temperatures. The second application concerns the validity of the Neumann-Kopp law, which states that the molecular heat of a compound is an additive property of the atomic heats. Prof. Jaeger's measurements show that, in the case of alloys, the law is obeyed only when true solid solutions are formed between the component metals. With intermetallic compounds, the deviations from additivity, which are sometimes very considerable, may be either positive or negative, and in all cases rapidly increase with the temperature of observation.

O. J. WALKER.

# Insect Pests of Crops in England*

THE Ministry of Agriculture and Fisheries' report for 1932–34 on insects affecting crops has been drawn up by Mr. J. C. F. Fryer, in collaboration with his colleagues at the Plant Pathological Laboratory, Harpenden. In dealing with advances in the application of insecticidal measures, the subject of pyrethrum is again considered in this report. Methods for the evaluation of the toxic principles of pyrethrum, elaborated by Dr. F. Tattersfield at the Rothamsted Station, have proved valuable, and it has been further shown that the incorporation of certain anti-oxidants greatly retards the deterioration of pyrethrum dust when exposed to the air. The plant has been shown to grow, and to yield satisfactorily, under English conditions; but the available methods of harvesting entail too heavy labour costs to warrant cultivation as a paying proposition. This aspect, therefore, remains in abeyance, at any rate for the time being, but in view of the valuable properties of pyrethrum, and the safety attending its application as a spray fluid, we may hope that cultural difficulties will eventually be overcome.

The hot-water treatment of daffodil bulbs as a measure against the Merodon fly and nematode pests is now an established procedure, and the same method has now become applicable in respect to the *Tarsonemus* mite of the strawberry. The treatment has been further developed with reference to strawberries, chrysanthemums and violets.

Among introduced pests, the Colorado potato beetle is of great importance: the recent eradication of a slight infestation in the Tilbury–Gravesend area is a matter for congratulation to all concerned. But for the prompt measures put in force by the Ministry, this insect might have gained a foothold, and led to a veritable campaign for its eradication. The extent of its adopted area in France, and its continued spread in that country, will serve as a justification for the close scrutiny that is being maintained at likely English ports of ingress.

Among other foreign pests that have found entry into Great Britain, reports on the eradication of the chrysanthemum midge and fluted scale are satisfactory, and measures to preclude the introduction of the apple maggot and cherry fruit fly have given the effective results anticipated. During the period under review, many indigenous crop pests are mentioned. There were no very outstanding attacks on cereals but with regard to potatoes, the *Heterodera* eelworm was a serious menace and appeared to be spreading. Larvæ of chafer beetles were specially in evidence as pests of grassland, while in connexion with sugar beet cultivation, the discovery of the *Heterodera* potato eelworm in that crop has complicated the situation. Proper rotation and clean cultivation may avert the severe losses which this creature has brought about on the continent of Europe. *Brassica* crops came in for heavy infestation by the aphis *Brevicoryne*, flea beetles and the cabbage white fly—dry weather conditions seemingly having favoured such attacks.

Fruit pests are always numerous: the apple sawfly attracted most attention, but the application of

* Ministry of Agriculture and Fisheries. Bulletin No. 90: Report on Insect Pests of Crops in England and Wales, 1932–1934. Pp. vi+50. (London: H.M. Stationery Office, 1936.) 1s. net.

proper measures, when carefully timed, reduced the menace to manageable proportions. The deterioration of strawberries has greatly concerned growers, and the discovery that the disease known as 'yellow edge' is carried by a prevalent species of aphis has added to the importance of the latter as a pest. Among glass-house troubles, the record of damage to tomato seedlings by a species of the order Symphyla during the three successive years under review is of interest. Much damage has been claimed as being due to such creatures in America in recent years, but the status of this species as a pest is not as yet universally accepted.

The report concludes with a useful bibliography of publications bearing upon the subjects dealt with.

A. D. I.

# The Marine Steam Boiler

IN a recent note on "The Future of Steam Propulsion", reference was made to a paper on the relative merits of steam and oil engines for ships (NATURE, **137**, 267; 1936). The subject is one of considerable importance at the present time, when a period of increased ship construction is imminent, and a new and different 'battle of the boilers' such as occurred at the time of the introduction of the water-tube boiler into H.M. Navy may be anticipated. Two papers dealing with the matter were read before the spring meeting of the Institution of Naval Architects in April last. In one of these, a "Review of the Present Position of Marine Steam Boilers", Eng.-Rear-Admiral W. M. Whayman dealt with large high-speed ocean-going mail steamers and passenger liners; he holds that these services constitute practically an exclusive field for steam machinery. Asserting that oil is, at present, the only suitable fuel for such installations, he points to the fact that, where speed and passenger comfort are the main consideration, oil-fired water-tube boilers have been adopted for ocean liners in all countries, and he gives details of the boiler equipment of many well-known ships. Whereas pressures on shore approach 1,500 lb. per sq. inch at 900° F. the tabulated figures show that 400–450 lb. per sq. in. and 650°–740° F. constitute the generally accepted limits for high-class sea installations at present. It is suggested that by reason of the more severe conditions of sea service, these pressures and temperatures may be expected to remain fairly steady. It should, however, be recognized that since these special sea conditions must always exist, marine practice, while necessarily following land practice at a safe distance, will steadily advance as quickly as new methods, machinery and means of operation have been proved to be sufficiently reliable for service at sea.

The water-tube boiler, by reason of the much smaller diameters used as compared with the Scotch type, has enabled pressures to be nearly doubled, and the present tendency towards the elimination of the drum makes possible further advances in working pressures. Towards this end also the use of higher tensile alloy steels, the adoption of welding processes, the provision of air heaters, and the introduction of forced circulation, of pure feed supply and of methods of treating the steam between the turbines either by re-heating or by extraction of moisture, indicate the lines on which improvements may be anticipated.

In "Naval Water-tube Boilers", Eng.-Capt. S. R. Dight gave particulars of tests and experiments which have been carried out at the Admiralty Fuel Experimental Station, Haslar, with the object of obtaining more intimate information regarding the internal working conditions, and so enabling further improvements in efficiency and reliability to be made. Circulation was tested by means of Pitot tubes, and marked variations were noted between differently placed tubes, with occasional reversals occurring in fire-row tubes when sudden changes took place in the feed supply.

A device described as a circulation augmenter was introduced to enable the feed supply to assist circulation, and proved advantageous. The overheating of fire-row tubes, the use of air pre-heaters and of automatic feed regulators were among the subjects of test, and the general conclusion was that increase of output for the same space and weight was possible. The application of forced circulation is stated to be under consideration.

# Breeding of Arctic Marine Prosobranchs*

DR. GUNNAR THORSON accompanied the Danish Three-Year Expedition to East Greenland in 1931–34 under the leadership of Dr. Lange Koch, and made extensive and regular collections of plankton from the southern main station of Ella Island during the period from January until September 1932. Later, these samples were supplemented by others collected by a Greenlander, Benjamin Samuelsen; thus giving a whole annual cycle of East Greenland plankton. In none of these samples and in none previously examined from these regions were there any prosobranchiate gastropods. This remarkable fact was partially explained by the large number of different prosobranchiate egg capsules with big embryos in the bottom samples and dredged material.

In order to investigate further, Dr. Thorson continued the collecting of gastropod egg-masses in 1932 and during the cruise of the *Godthaab* in the summer of 1933, and in addition examined material from other expeditions. By carefully studying the species in their various habitats and their distribution, and

* "Studies of the Egg-Capsules and Development of Arctic Marine Prosobranchs" by Gunnar Thorson. Treaarsexpeditionen til Christian den X's Land 1931–1934 under Ledelse af Lange Koch. *Medd. om Grønland*, **100**, No. 5 (1935).

by comparing the embryos with the adults a good knowledge of the prosobranchiate fauna was obtained, with their breeding, resulting in the discovery that not one species has a pelagic larva, but all pass directly into the free bottom stage after they have reached a considerable size in their capsules. Alone of the twenty-eight Greenland molluscs noted (in twenty of which the breeding is described for the first time) *Acmaea rubella* was found to be viviparous and hermaphrodite.

The present paper deals with the egg capsules and enclosed embryos, their breeding seasons and habitats (very characteristic in most cases). The young in the capsules were identified by comparing the shell with the apex of the adult, which is very different from the rest of the shell and gives a perfectly good clue to the embryonic period. Whenever possible the size and shape of the capsules, description of embryos, duration of embryonic state and number of embryos in each capsule are given. In many cases, especially in the large species, there are nurse eggs. In *Siphocurtus* about eight hundred eggs are laid in each capsule, of which usually only two develop into shelled embryos which devour the others. It is found that the number of embryonic whorls in a species is not always constant, but depends upon the conditions of nourishment in the capsules, and the time of escape of the embryos depends on the amount of nourishment.

The fact that these arctic species have no pelagic larvæ is very important, especially when we compare closely related species from Britain and elsewhere, and find that many of these have distinct veliger larvæ which often stay in the plankton until several whorls are attained. With the larger forms such as *Buccinum* and *Neptunea*, the young emerge in the crawling stage in both Arctic and British waters, but the British turrids and the species of *Natica* and *Velutina* whose larvæ are known all have well-developed veligers which remain in the plankton for a considerable time.

The author does not in this paper make any suggestions as to the special conditions in these Arctic waters which apparently prevent any pelagic prosobranch larvæ from living. One anticipates with interest a discussion on these general problems.

# Radio Research in Australia

IT is with considerable satisfaction that those responsible for the organization of radio research in Great Britain will note the continued activity of the Australian Radio Research Board as shown by the seventh Annual Report for the year ended June 30, 1935, recently issued by the Commonwealth Council for Scientific and Industrial Research[1]. Some of the papers published during the year under review have already been noticed (NATURE, 136, 650; 1935) and further papers have just been issued in Report No. 9.

Investigations connected with the fading of radio signals and the transmission of waves through the ionosphere have been continued with the aid of fresh modes of attack and advances in technique. A new method of carrying out frequency-change emissions for the recording of interference fringes at the receiving station has been developed, involving the production and separation of modulation sidebands at the transmitter. It is pointed out that one of the methods of controlling the wireless signal variations, commonly known as fading, is to emit signals simultaneously on a number of adjacent carrier frequencies; and some preliminary experiments have been carried out to ascertain the possibilities of this technique as applied to radiotelephony circuits. In the field of atmospherics, observations of direction, wave form and intensity are being continued as a long-term investigation. Most of the evidence supports the now generally accepted view that every atmospheric originates in a storm centre and probably in an actual lightning flash. From the study of intensities of atmospherics from lightning at known distances, it has been estimated that the equivalent power of a lightning flash is about 2 kw. for a receiver tuned to 1,000 kc./sec. and with a band-width of 20 kc./sec.; the total peak radiated power is probably of the order of 100,000 kw. The application of the knowledge obtained in this work to interference with broadcast reception, to meteorology and particularly in reference to aircraft navigation at night, receives continuous consideration in Australia.

The Annual Report acknowledges the co-operation which the Radio Research Board has received from such institutions as the Postmaster General's Department, the Universities of Melbourne and Sydney, the Department of Defence, and the Commonwealth Solar Observatory and Meteorological Bureau. The Board also welcomes the indication of the way its staff is regarded by industry, given by the fact that two of its members have recently resigned to take up industrial appointments.

The other publication recently issued, No. 9 in the series of Reports of the Australian Radio Research Board[2], contains seven papers. The first two papers deal with the study of the magneto-ionic theory of wave-propagation. A graphical method to facilitate this study, worked out by Prof. V. A. Bailey, has been applied by Dr. D. F. Martyn to the calculation of dispersion, absorption and polarisation curves for five typical wave-lengths between 100 m. and 20,000 m.

In the third paper, Mr. J. H. Piddington describes an investigation of the causes of frequency variation of a dynatron valve oscillator, and indicates the manner in which such variations may be reduced. Two of the papers by Dr. G. Builder deal with certain aspects of circuit technique as applied to radio reception, while a third describes a useful and robust thermionic voltmeter having four ranges between 0–5 and 0–500 volts. The last paper in the Report is by Mr. Piddington, and this describes the principles and design of a novel form of harmonic analyser, which operates by suppressing the fundamental frequency and measuring the harmonics with a cathode ray tube outfit or a thermionic voltmeter.

[1] Reprinted from the *Journal* of the Council for Scientific and Industrial Research, Vol. 8, No. 4, November, 1935. (Melbourne: Government Printer.)

[2] Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 95: Radio Research Board, Report No. 9. Pp. 71. (Melbourne: Government Printer, 1936.)

## Educational Topics and Events

BIRMINGHAM.—Mr. C. G. Parsons has been awarded a Walter Myers travelling studentship to be used in research in the United States on anæmia.

The following appointments have been announced: Dr. M. Stacey to be lecturer and Mr. F. Smith assistant lecturer in chemistry; Dr. A. Lamont to be assistant lecturer in geology; Mr. J. W. Drinkwater to be lecturer in mechanical engineering.

CAMBRIDGE.—Mr. A. L. Hodgkin, of Trinity College, has been elected to the Michael Foster studentship in physiology, which is offered annually for the encouragement of research. The value of the studentship is £105.

At King's College, O. L. Zangwill and J. W. S. Pringle have been elected to Martin Thackeray studentships.

LEEDS.—The Lord Mayor of Leeds has given a capital sum to provide an annual prize in clinical dental surgery, to be known as the Percy Leigh Prize.

The following appointments have recently been made: J. C. Gregory, to be honorary lecturer in the history of science; Dr. Frank C. Happold, at present lecturer in pathology and bacteriology, to be lecturer in biochemistry; H. R. Noltie, to be lecturer in physiology; W. Hobson, to be part-time lecturer in physiology and hygiene; G. D. A. MacDougall, to be assistant lecturer in economics.

WALES.—At the University Congregation held on July 22 at Bangor the honorary degree of D.Sc. was conferred on Prof. A. A. Read, emeritus professor of metallurgy in University College, Cardiff.

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ADULT education in the United States has in the past been academic in scope and method, depending in the main for its inspiration and agencies on the universities through their 'university extension' departments. With the inauguration in a number of States of large-scale projects on the lines of the Des Moines "Public Affairs Forums", it has entered upon a new phase in which it finds inspiration and objectives that are frankly political. In his bulletin "Education for Democracy: Public Affairs Forums" (Superintendent of Documents, Washington, price 10 cents), the United States Commissioner of Education attempts a partial answer to the question "How can we make democracy work?" The success of American democracy depends very largely, he holds, upon how much understanding of our common problems can be diffused among the people, and he suggests that such understanding can be most rapidly and effectively promoted through the instrumentality of public forums to be established throughout the country and conducted on the lines of those which have been for the past four years in successful operation in Des Moines. In this city of 140,000 inhabitants some twenty-five 'small-neighbourhood' forums, five large-district forums and one city-wide forum were attended in 1934 by 70,000 adults. Distinctive features of the system are: it is administered as a fundamental part of the public school system under the control of the local education authority; the forum meetings are conducted by expert leaders; corresponding with the varying size and composition of the membership various techniques are used.

## Science News a Century Ago

### Suspended Animation

THE *Indian Journal of Medical and Physical Science* of August 1, 1836, gives the following account of a man who submitted to be buried alive for a month and was dug out alive at the end of that period: "He is a youngish man, about 30 years of age . . . he generally travels about the country, and allows himself to be buried for weeks or months by any person who will pay him handsomely for the same. The man is said by long practice to have acquired the art of holding his breath by shutting the mouth and stopping the interior opening of the nostrils with his tongue; he also abstains from solid food for some days previous to his internment, so that he may not be inconvenienced by the contents of his stomach, while put up in his narrow grave; and, moreover, he is sewn up in a bag of cloth, and the cell is lined with masonry, and floored with cloth so that the white ants and other insects may not easily be able to molest him. The place in which he was buried at Jaisulmer is a small building about 12 ft. by 6 ft., built of stone, and in the floor was a hole about 3 ft. long, 2½ ft. wide, and the same depth, in which he was placed in a sitting posture, sewed up in his shroud, with his feet turned inwards towards the stomach, and his hands also pointed inwards towards the chest. Two heavy slabs of stone, 5 or 6 ft. long, several in. thick and broad enough to cover the mouth of the grave, so that he could not escape, were then placed over him. The door of the house was also built up, and people placed outside that no trick might be played. At the expiration of a full month the walling up of the door was broken and the buried man dug out of his grave. . . . He was taken out in a perfectly senseless state, his eyes closed, his hands cramped and powerless, his stomach shrunk very much, and his teeth jammed so fast together that they were forced to open his mouth with an iron instrument to force a little water down his throat. He gradually recovered his senses and the use of his limbs".

### Disease in Elm Trees

AT a meeting of the Entomological Society held on August 4, 1836, a letter was read from Mr. Spence giving an account of the destruction of elm trees in the promenades of Dunkirk, Boulogne and Calais, by *Scolytus destructor*. The decay of the trees had there, as in many other cases, been attributed to wind, soil and various other causes; but the writer was convinced it was owing to the one he had assigned, regarding which he had gained much information. Mr. Westwood added some observations on the extensive injury sustained by the elm trees in Kensington Gardens, London, the majority of those on the south side being dead. He considered that the Society, having accumulated a large mass of information on the subject, should hold an official communication with the commissioner of Woods and Forests for the purpose of suggesting some means by which the ravages might be restrained, as they had already extended to the trees in Lord Holland's park and along the Western Road past Hammersmith. Some attempts at remedying the evil had recently been made with the young elms, by plastering them over with cow dung, which was, however, quite ineffectual, as the beetles might be

seen in thousands running over the covered surface. The neglect of the authorities was a matter of regret, as there could be no doubt that entomological science would cure the evil.

### Giraffes at the Zoological Gardens, London

A CORRESPONDENT writing to *The Times* said that the Zoological Society, "which is now extended to about 3000 members held their monthly meeting for the first time on Thursday last [Aug. 4, 1836] in the room which has been fitted up for that purpose, as also for the scientific meetings which are held every fortnight, at the new museum in Leicester-square, the collection of preserved specimens having been removed from Bruton-street". In the report of the council read at the meeting it was stated that M. Thibaut, who had secured the giraffes for the Society, had now left England. The total cost and expenses connected with the four giraffes had been about £2,340. A building for their accommodation would be ready by October, and it was proposed to heat this by air which had passed through pipes surrounded by hot water, a plan suggested by Mr. Sylvester.

### Terrestrial Magnetism in Chile

IN its columns of Miscellanea, the *Athenæum* of August 6, 1836, said: "M. Gay, residing in Chile, has communicated to the French Academy of Sciences that at the time of the great earthquake in that country in February 1835, he observed great variations in the diurnal movements of the needle; but in the lesser shocks the variations were feeble. His observations amount to more than two thousand, all of which have proved to him, that magnetic phenomena are much more complete in that part of the world than in Europe; for instead of two daily movements he obtained three: one in the morning in the East, another in the middle of the day in the West, and a third in the evening to the East again. This triple movement he considers as permanent, and suggests the great chain of the Cordilleras as one of the influential causes."

### Education of French Pharmacists

IN the *Records of General Science* of August 1836 is a note on the French School of Pharmacy. The object of this School, it said, is to teach all the sciences connected with pharmacy, and to receive such apothecaries as in four trials prove they possess the requisite knowledge for exercising this profession. Every candidate must produce certificates of his having studied for eight years—of his having attained his twenty-fifth year, and must place in the hands of the treasurer the sum of 1,300 francs. The School consists of a director, a joint-director, ten professors, of which four are joint-professors, and a treasurer. The necessary examinations are two upon theory, one of which is upon the principles of the art, the other upon the botany and natural history of simple drugs, and a third and fourth on the practice of the art which last for four days and consist of at least ten chemical or pharmaceutical operations, which the candidate must perform himself, describing the process, materials and results. The existence of this establishment thus enables every apothecary in France to be a chemist; while in England, whoever heard of an apothecary being a chemist or of doing anything for the improvement of pharmacy?

## Societies and Academies

### Paris

Academy of Sciences, June 22 (*C.R.*, **202**, 2021–2108).

ERNEST ESCLANGON: Observations of the eclipse of the sun of June 19, 1936. Observations of Nova Cephei and Peltier's comet. The partial eclipse in France was observed under excellent conditions at Paris, Meudon, Besançon and Bourges.

VITO VOLTERRA: The canonical equations of biological fluctuations.

W. DOEBLIN and PAUL LÉVY: The sums of contingent independent variables with lower restricted dispersions.

B. HOSTINSKY: Movements depending on chance.

OCTAV ONICESCU and G. MIHOC: Statistical chains.

CHARLES EHRESMANN: The notion of complete space in differential geometry.

DAVID WOLKOWITSCH: A family of surfaces of the fourth order.

VICTOR LALAN: Two groups of transformations defined by geodesy.

ARMAND RAUCH: Integral algebroids.

HENRI PONCIN: The search for the conditions of stability of a limiting surface of cavitation.

LÉOPOLD ESCANDE and GEORGES SABATHE: Experiments on the piers of bridges or of mobile dams with aerodynamic profile.

CHARLES BERTAUD: The star stream of Scorpio-Centaurus.

ROGER MÉRIGOUX: The movement of contaminated liquid surfaces.

PIERRE JOLIVET: A cause of the small power of electrostatic machines and a means of remedying this. The yield is increased by enclosing the electrostatic machine in a vessel containing air under pressure.

ALEXANDRE MARCEL MONNIER and JOSEPH BAZIN: A continuous voltage amplifier.

PIERRE GIRARD and PAUL ABADIE: Molecular interactions and chemical affinity.

LADISLAS GOLDSTEIN: Collisions of the second kind and electronic affinity.

ROBERT FORRER: Electrons, carriers in supraconduction.

LÉON CAPDECOMME: The substitution of surfaces in comparisons of reflective powers by means of the microscope. Discussions of the magnitude of the errors and precautions to be taken for reducing them.

LEWI HERMAN and MME. RENÉE HERMAN-MONTAGNE: The absorption coefficients of the bands 4774, 5770 and 6290 A. of oxygen. As found by Janssen, the absorption varies proportionally to the square of the pressure. A table is given for calculating the optical densities of atmospheric oxygen for different zenithal distances, neglecting the influence of temperature.

MAURICE ROULLEAU: The spectral transmission of developed photographic emulsions.

MLLE. YVETTE CAUCHOIS: Observation and measurement of the $L\alpha$ satellites for the elements 72, 73, 75, 83, 90 and 92. The presence of satellites has been definitely proved and this suggests the necessity of modifying or completing certain recent theoretical conceptions.

AURELIO MARQUES DA SILVA: The materialization of the energy of the $\beta$-rays of radium C.

ALBERT PORTEVIN and PAUL BASTIEN: The mechanical study of the malleability of various types of light and ultra-light alloys. A study of the best conditions for hot working of aluminium and its alloys with copper and magnesium.

ERNEST TOPORESCU: The transformation of urea into ammonium carbonate. Some ammonia is produced by dialysing a solution of urea containing sodium chloride.

RENÉ PARIS and P. MONDAIN MONVAL: The crystallization of zinc borate. A contribution to the study of the conditions of the devitrification of glass.

MLLE. SUZANNE VEIL: The Liesegang periodicity and the concentration of the reagent drop.

RAYMOND ZOUCKERMANN and RENÉ FREYMANN: The high-frequency absorption of various alcohols. For a given wave-length, going up a homologous series, the conductivity rapidly increases, tending to become constant starting with the term $C_6$. This fact does not follow from Debye's theory, nor from the experiments of Malsch.

GUY GIRE and FERNAND RIVENQ: The hydrolysis of solutions of pentavalent vanadium.

ETIENNE CANALS, MAX MOUSSERON, LOUIS SOUCHE and PIERRE PEYROT: The Raman spectra of some substituted epoxycyclohexanes.

ANDRÉ DUPIRE: Contribution to the study of the borates of the polyalcohols. Pure boric esters can be obtained by azeotropic distillation with toluene.

MARCEL PATRY: Esters of polymetatelluric acid.

PIERRE LEGOUX: The relations between the granitogneiss and the schists and quartzites in western Africa.

MARCEL GAUTIER: The tectonic of the Nemours region.

MARCEL MASCRÉ: The action of acrolein on the structure of the plant cell.

ROBERT QUETEL: The variations in the proportion of nitrogen in the lily-of-the-valley during forcing.

EMILE MIÈGE: Experimental cultures of the potato in Morocco in 1935 in the mountains and on the plain. Whatever the origin and mode of preservation of the tubers sown, the yields are always greater in the mountains.

ROGER HEIM: The relationship between *Lactarius* and certain Gasteromycetes.

PIERRE DRACH: The cycle traversed between two moults and the principal stages in *Cancer pagurus*.

GABRIEL GUIGNON: The study of the blood circulation of the wings in Coleoptera and Orthoptera by means of nicotine.

RAOUL MICHEL MAY and MLLE. ALICE FRANK: The replacement of an anterior foot by a grafted bulb, in the embryo of *Discoglossus*, and its relations with the law of bilateral symmetry of the neurones.

## Amsterdam

Royal Academy (*Proc.*, 39, No. 5, 1936).

L. S. ORNSTEIN, C. JANSSEN, D. T. J. TER HORST, C. KRIJGSMAN and G. H. FREDERIK: Investigation of transformer oil. Physical studies of ageing.

W. H. KEESOM and P. H. VAN LAER: Measurements of the latent heat of tin in passing from the supraconductive to the non-supraconductive state.

W. H. KEESOM and A. BIJL: Comparison of platinum resistance thermometers with the helium thermometer from −190° C. to −258° C.

R. WEITZENBÖCK: The theory of semi-invariants.

J. G. VAN DER CORPUT: (1) Distribution functions (8). (2) On some Vinogradoff methods (3).

E. COHEN and A. K. W. A. VAN LIESHOUT: An electrical pressure dilatometer. Apparatus for the study of polymorphic transformations at pressures up to 200 atm.

A. H. BLAAUW, IDA LUYTEN and ANNIE M. HARTSEMA: Accelerated flowering of Dutch irises (1).

J. J. VAN LAAR: Variation of some thermal and calorimetric quantities along the two melting curves of helium.

A. G. BOER, E. H. REERINK, A. VAN WIJK and J. VAN NIEKERK: A naturally occurring chicken provitamin D. The isolation and chemical nature of a provitamin D from cholesterol.

K. MAHLER: An analogue to a theorem of Schneider.

H. FREUDENTHAL: Partially ordered moduli.

J. BEINTEMA: Crystal structure of barium antimonate. X-ray and crystallographic examination of $Ba(Sb(OH)_6)_2.2H_2O$.

D. TAPPENBECK: Tertiary Foraminiferan rocks of Sipoera (Mentawei Islands).

W. VAN TONGEREN: Mineralogical and chemical composition of the syenite-granite from Boekit Batoe near Palembang, Sumatra, Dutch East Indies.

H. A. BARKER: Fermentation of some diabasic $C_4$ acids by *Aerobacter aerogenes*. The process involves an initial oxidation-reduction between two molecules of the substrate and a subsequent decomposition of the oxidized molecule.

B. VAN DER EYKEN: Dentition and teeth development in the irisforelle (*Salmo irideus*) (5). Palate and pharynx.

D. WIERSMA: Imagination and attention during childhood.

A. GEESINK, H. DE JONG and F. J. NIEUWENHUYZEN: Experimental catatonia produced by autointoxication. (2) Experimental catatonia after ligation of the arteria hepatica propria.

H. A. MEYLING: The glomus caroticum and the sinus caroticus of the horse.

## Cape Town

Royal Society, May 20.

MRS. M. R. LEVYNS: Notes on the genus *Stoebe*. *Stoebe* falls into two well-marked sections based on distinct types of floral structure. One type is widespread in Africa and extends to Madagascar and Reunion. Distribution of species of this type is predominantly discontinuous. The other type (comprising most of the species) is almost confined to the south-west Cape and the species have, with few exceptions, a restricted and continuous distributional range. The distribution supports the view that the south-western flora at one time occupied a much larger area than it does to-day.

J. L. B. SMITH: Fishes new to South Africa.

## Vienna

Academy of Sciences, May 7.

LEOPOLD SCHMID, SIEGMUND MARGULIES and SIDONIE LENZER: Chemical investigation of amber.

LEOPOLD SCHMID and HUGO KÖRPERTH: (1) The colouring matter of the poppy (*Papaver rhoeas*, L.). (2) Examination of extracts of petals. The chemical nature of the colouring matter of ten flowers is given.

GEORG KOLLER and HERMANN HAMBURG : Rhodocladonic acid.

PHILIPP GROSS and HANS SUESS : Thermal decomposition of dioxane.

H. DOSTAL and R. RAFF : The mechanism of thermal polycondensation reactions.

B. ORMONT and B. A. PETROW : Thermal decomposition of simple and complex cyanides with formation of alkali metals, with special reference to potassium.

W. J. MÜLLER, H. FREISSLER and E. PLETTINGER : Anodic behaviour of gold-copper alloys in 5*N* hydrochloric acid and *N* sulphuric acid. The relative quantities of gold and copper dissolved out of alloys of various compositions are measured when these are made the anode in acid solutions.

W. J. MÜLLER and E. LÖW : (1) The influence of the purity of aluminium upon corrosion in hydrochloric acid of varying concentration. (2) Theory of corrosion phenomena. Part 4. Application of the theory of local elements to the problem of corrosion.

ALFRED LICHTENFELD and KARL SCHWARZ : The theory of Kikuchi lines studied by means of models. Light is transmitted through a 3-dimensional grating having a spacing of about 1000 λ and bright lines are formed on a screen behind the grating.

F. SEIDL : (1) Electrical conductivity of solidified melts of Rochelle salt. Conduction in Rochelle salt is found to be ionic in nature. (2) Electrical behaviour of single crystals of Rochelle salt crystallized from saturated solutions in an electric field.

HERBERT HABERLANDT : Radioactive haloes in fluorite from Striegau.

MAX TOPERCZER : Contribution of the data of the magnetic survey of Austria in 1930.0 to the study of the earth's magnetic field. (2) Improvement of some values of the vertical intensity.

WILHELM SCHMIDT : Vertical motion in clouds studied by cinematograph pictures. Vertical motion of any part of a cloud is detected by placing two successive photographs of the cloud in a stereocomparator.

NORBERT LICHTENECKER : Glacier research in the Sonnblick in 1930–34.

F. STEINHAUSER : Probability of precipitation in the eastern Alps.

H. TOLLNER : Glacier winds on the Pasterze glacier.

ERHARD BRAUMÜLLER : The north boundary of the Tauern between the Fusch and Rauris valleys.

SIEGMUND PREY : The possibility of the emergence of the Dent Blanche nappe in the Sonnblick.

GABRIELE ROGENHOFER : Action of growth-promoting substances on bark formation in woody shoots.

HELMUTH ZAPFE : The possibility of aragonite surviving the fossilization process investigated by means of the Feigl-Leitmeier reagent.

EMIL ABEL and A. BILDERMANN : Kinetics of the oxidation of formic acid by iodic acid.

WALTER KOSMATH, VOLKMAR HARTMAIR and OTTO GERKE : Contribution of plant physiology towards the assessment of the biological or balneological importance of the radioactivity of the treatment at Bad-Gastein.

May 14.

FRANZ RINAGL : The importance of the upper elastic limit. By making use of the bending of bars of various cross-sections, trustworthy values of the upper elastic limit are obtainable.

# Official Publications Received

## Great Britain and Ireland

*Department of Statistics, University of London :* University College. Statistical Research Memoirs. Vol. 1. Edited by J. Neyman and E. S. Pearson. Pp. v+161. (London : University College.) 15*s*. net. [87

The International Institute for Psychical Research, Ltd. Bulletin 3 : Enquiry into the Cloud-Chamber Method of Studying the "Intra-Atomic Quantity". By B. J. Hopper. Pp. 16+2 plates. (London : International Institute for Psychical Research, Ltd.) 2*s*. [97

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1935. Pp. iv+669+11 plates. (London : H. M. Stationery Office.) 15*s*. net. [107

The National Trust for Places of Historic Interest or Natural Beauty. Report 1935–1936. Pp. ix+126. Freehold and Leasehold Properties of the Trust and Protected Properties. Pp. xv+34+24+8 plates. (London : The National Trust.) [107

## Other Countries

Meddelelser om Grønland. Band 78, Nr. 3 : The Godthaab Expedition 1928—The Hydrographic Work and Material. By Eigel-Riis-Carstensen. Pp. 101+12 plates. 6.00 kr. Band 80, Nr. 1 : The Godthaab Expedition 1928—Crustacea Decapoda. By K. Stephenson. Pp. 94. 4.50 kr. Band 80, Nr. 2 : The Godthaab Expedition 1928—Crustacea Varia. By K. Stephenson. Pp. 38. 1.75 kr. Band 93, Nr. 5 : Fossil Plants from Kingigtok and Kagdlunguak, West Greenland. By A. C. Seward and Verona M. Conway. Pp. 41+5 plates. 2.50 kr. Band 93, Nr. 7 : Der Grönländische Moschusochse, *Ovibos moschatus wardi* Lydekker. Von Alwin Pedersen. Pp. 82. 4.00 kr. Band 95, Nr. 6 : Treaarsexpeditionen til Christian den X's Land 1931–34—Zur Regelung der Gesteine im Kristallin von Liverpool-Land in Ostgrönland. Von Th. G. Sahlstein. Pp. 27+7 plates. 2.00 kr. Band 99, Nr. 3 : Treaarsexpeditionen til Christian den X's Land 1931–34—The Upper Jurassic Invertebrate Faunas of Cape Leslie, Milne Land. 2 : Upper Kimmeridgian and Portlandian. By L. F. Spath. Pp. 180+50 plates. 13.00 kr. Band 100, Nr. 8 : Treaarsexpeditionen til Christian den X's Land 1931–34—Investigations on the Shore Fauna of East Greenland with a Survey of the Shores of other Arctic Regions. By Holger Madsen. Pp. 79. 4.00 kr. Band 102, Nr. 2 : Treaarsexpeditionen til Christian den X's Land 1931–34—Eskimo Settlements in Kempe Fjord and King Oscar Fjord. By P. V. Glob, with a Zoological Appendix, by M. Degerbøl. Pp. 97+7 plates. 5.00 kr. Band 104, Nr. 6 : The Scoresby Sound Committee's 2nd East Greenland Expedition in 1932 to King Christian IX's Land—Insects and Arachnids. By Jens Braendegaard, Kai L. Henriksen and R. Spärck. Pp. 18. 1.00 kr. (København : C. A. Reitzel's Forlag.) [296

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# Purposes of University Education

IN the plea for devising an education which would secure for us representatives capable of co-operating intelligently with technical experts in constructive social enterprise and would also teach us how to choose them, which formed one theme of his Conway Memorial Lecture (see NATURE of July 25, p. 139), Prof. L. Hogben uttered a warning against the teaching of science for vocational purposes which deserves close attention. He raises essentially the same question regarding all education that was raised of university education by the recent report of the University Grants Committee (see NATURE of June 27, p. 1057), and the wider question should in fact be faced before we really formulate our answer to the question, what is the purpose of university education.

The valuable study of education for citizenship in secondary schools, issued early this year under the auspices of the Association for Education in Citizenship (London: Oxford University Press. 5s. to non-members; 3s. 6d. to members), directed attention to the inadequacy of indirect education for citizenship to-day. Experience has shown that a man with a good general education based on languages or science may be an excellent father, an excellent business or professional man and at the same time a bad citizen. The political world has become so complex and difficult that it is essential to train men just as consciously and deliberately for their duties as citizens as for their vocation or profession.

The monograph to which we have just referred proceeds to discuss how the direct teaching of citizenship may be achieved, particularly by linking it to the subjects at present taught in secondary schools. Prof. Doris L. Mackinnon, for example, suggests that it is a prime duty of the teacher of science to let the pupil understand from the beginning what are the responsibilities in common life which the scientific discipline lays on all those who have once submitted to it. Moreover, the suggestions in regard to the teaching of clear and of accurate thinking made by Prof. G. C. Field and Dr. R. H. Thouless are scarcely needed more in any section of the community than in regard to the training of the scientific worker.

The present unsatisfactory position arises in fact from the growing tendency towards vocational education, and perhaps more particularly the teaching of science for vocational purposes. Already this has invaded the public and other secondary schools and spread far beyond the universities and technical colleges. In a highly organized society political administration must be the vocation of certain people. It is also true that intelligent citizenship is no longer possible without some understanding of the place of science in the everyday life of the whole nation; and the teaching of science needs to be adapted to such requirements rather than to those of assisting the few to gain a livelihood in a particular way.

If, therefore, we could re-orientate the teaching of science in both post-primary and secondary schools so that it would be taught as part of the equipment of everyone for living in a scientific age, and not as the first stage in preparation for a career in science, we should have taken one step to facilitate co-operation between the technical expert and the political administrator. If, further, by means of training for citizenship on the lines advocated by the Association for Education in Citizenship, we could ensure that those entering a university had received at any rate some equipment in this respect before embarking on their specialized studies, we should be in a much

sounder position to discuss the question of the quality and quantity of university education.

As the report of the University Grants Committee points out, the engineer, chemist, medical man or schoolmaster trained at a university is rightly expected to have received a sound technical training in the particular calling or subject he has studied. Whether he has also received that stimulation and enrichment of the whole mind which enable him to lead a fuller and more interesting human life, and to play more adequately his part as member or leader of the community, must depend at least partly on the way in which he has been prepared for the training he receives at the university.

If the tendency to specialize at a too early age, and particularly in the later years of school life, has had insidious consequences and needs to be resisted strenuously, at least it should teach us that there can be no hard and fast separation between secondary education and university education. One must be planned in relation to the other, and we cannot throw on the university stage the whole responsibility of training a man not only as a skilled worker but also as a member of society and a human being.

The special responsibilities of the universities in this field must of course be recognized. Industrial and commercial appointments are being thrown open to university graduates over an increasingly wide field. The growing extent to which leadership in commerce and industry, like that in national and local administration, is passing under the influence of professional men, means that the great majority of those who become leaders in the national life will continue to be drawn from those who have received a university training. No university can fail to recognize the opportunities of service in ensuring conditions of training which enable its students to go into the world with minds richly informed, unsleeping in the exercise of a critical intelligence and imaginatively alive to the human issues underlying the decisions they may be called upon to take.

The importance of giving due attention to these fundamental issues at the present time can scarcely be over-emphasized. Mechanization of thought is a peril in Great Britain as in other countries, and the suppression in the universities of several European and other countries of all independent thought and critical discussion of the principles of government, or of the meaning of life, throws a special responsibility upon British universities if the Greek tradition of candid and intrepid thinking about the fundamental issues of life is to be preserved for mankind.

Training for citizenship is a part of this wider question of training for life, but the two can scarcely be separated in any discussion of education to-day. Both the school and the university, each within its own limits, must endeavour to give its students a training for life, and this is even more important than training for a particular vocation or career. It is at last becoming more widely recognized that it is scarcely possible for a university to equip its students with the technical knowledge which might be expected to be of immediate use to them in any branch of industry they may enter on leaving the university. The detail of technical work can in fact be mastered only by practical experience after the student has left the university. The function of the universities in training scientific workers and technical men for industry is rather to give them such a knowledge of the principles of science and technology that they are able to bring trained minds to bear upon the understanding of practical problems which they encounter in their industrial or professional life.

The stimulation of thought, the widening of its horizons, the development of the faculty of judgment, and the evoking in its students of the energy of the soul in which Aristotle found the essence of true well-being, are the essential contributions to education which characterize the university rather than the schools. The dissatisfaction with many graduates of universities to-day is largely due to the fact that their primarily specialized training has robbed them of the essence of a university education and left them unequal to the demands which the major problems of life and industry make upon them when questions of value and judgment are involved. Moreover, specialization in itself is not so much criticized as premature specialization and the inadequate foundation upon which it is built, with the result that many of those completing long courses of study at a university in medicine or science, for example, are in danger of being uneducated persons.

Prof. Hogben showed convincingly in his lecture how ability to sort out the real issues, and to think clearly on the values as well as on the scientific and technical factors involved, are demanded today in our political leaders and in some degree in those who elect them. The professional aspects of after-life are to-day scarcely the major preoccupation of the universities, at least so far as they are

not linked up with the wider question of training in thought which they give to their students and of the linking of thought to action.

It is no part of the duty of a university to inculcate any particular philosophy of life. Never, however, was it more important than it is to-day that it should stimulate and train its graduates to think strenuously about the great issues of right and wrong, of liberty and government on which for the individual and for the community a balanced judgment is essential to a rational life. Without overlooking the place of research in the functions of a university or the desirability of upholding the value of learning for the sake of learning, the linking of knowledge to action is of such supreme importance at the present time that even the research activity of the universities needs to be re-orientated so as to secure that the advance of knowledge proceeds on a more even front. Only when our research effort is directed in some relation to the fundamental needs of society can we hope to redress some of the evils which the rapid advance in the physical sciences as compared with the biological or social has brought in its train.

An undoubted consequence of the redistribution of our comparative research effort between the physical and the biological and social sciences in the way urged by Dr. Julian Huxley or Prof. W. McDougall, for example, would be not merely the fertilization of thought in the social sciences and the breakdown of barriers between them but also the stimulation of thought generally in these fields. As in the physical sciences, we might witness significant advances through the overlapping of traditional disciplines in several branches of knowledge.

Given this redirection of research effort and the stimulation of thought in social and biological problems, the training of men and women who will bring unprejudiced minds, critical powers and moral courage to bear upon the new and difficult problems which they must meet in this era of physical science should become much simpler. To some extent, the absorption of the graduate into industrial or other employment may become a simpler problem because he will be better fitted to take any place as an intelligent member of the community, though the warning of the University Grants Committee in regard to the limitation of the members of those entering a university needs to be kept in mind. Nor can we overlook the importance of that early training for citizenship which those entering a university should share with those whose school education finishes at the post-primary or secondary school education stage. There at least must be laid a foundation from which a university can fittingly start to impart, not a mere training for livelihood, but a training for life and for leadership, so that its graduates are distinguished by a sense of values, a wide vision and a capacity for the creative thought and judgment which require only the ripening of experience to enable them to bring a trained mind to bear on any of the problems with which they may afterwards be confronted in their professional, industrial or civic life.

# Morphology of Muscles

**The Cranial Muscles of Vertebrates**
By Prof. F. H. Edgeworth. Pp. ix+493. (Cambridge: At the University Press, 1935.) £5 5s. 0d. net.

IN this large, copiously illustrated and splendidly produced volume, Prof. Edgeworth has brought together the knowledge which has been gained in the last hundred and fifty years of the comparative anatomy and embryology of the cranial muscles (and their motor nerves) in vertebrates. The author is well equipped for this task. Though not a professional zoologist—he was for many years, until recently, professor of medicine in the University of Bristol—he has long been a worker on this subject "so far as medical practice and teaching permitted", and has become widely known from his many published observations which have added to our knowledge of the subject.

This memoir is a notable and important contribution to vertebrate morphology, and contains the most complete account which has been published of the homologies of the cranial muscles. Its scope may be indicated by mention of the principal subjects discussed in its chapters. They begin with a discussion of the embryonic head mesoderm and its segmentation, of the relation of the muscle plates of the head to the myotomes of the body, and of the number of the branchial segments. The

author finds that in the cephalic mesoderm, premandibular, mandibular and hyoid segments are followed by a "branchial region" in which the number of segments varies in different phyla, and, as he has found, among the genera of any one phylum. He puts forward the view that this variability occurs not by the intercalation or dropping out of segments but by "the separation of the branchial region as a whole into a greater or a lesser number of segments than is usual in their respective phyla".

The chapters which follow show the extensive range of the author's observations on the development and anatomy of the cranial muscles in the vertebrates from the Dipnoi to mammals. The subjects dealt with include the external ocular muscles, the palato-quadrate bar in Ichthyopsida and Amphibia, the mandibular muscles and the palato-quadrate bar in Sauropsida, and the palato-quadrate and mandibular muscles in mammals.

Separate chapters deal with the hypobranchial skeleton and the hyoid muscles, the superficial facial and cervical muscles of mammals, and the branchial muscles. Considerable space is devoted to the description of the Cucullaris muscle, and the author presents a condensed but valuable account of this muscle throughout the vertebrates. The first stage in its phylogenetic history is represented in the Dipnoi, in which a muscle, the "constrictor branchialis V", extends back as a broad sheet, "whose ventral edge is attached to the pectoral girdle and coraco-branchialis V. Probably generally in Holocephali and Selachians it is developed from the dorsal ends of all five branchial muscle plates. These extend forwards and backwards and fuse together to form a longitudinal muscle, the anterior end of which becomes attached to the cranium and its posterior end to the shoulder girdle. It is innervated by a branch of the 'R. intestinalis X', the fibres of which can be traced from the caudal, exclusively motor, fibres of the vagus or vago-accessorius.

"A cucullaris is present in most of the Amphibia and in the Reptilia. In birds there is no cucullaris —its function is taken over by the cranio-cervicalis, which also extends from the head to the shoulder girdle, but is innervated by a different nerve, the N, hypoglosso-accessorius. In mammals a cucullaris is present, developed from the most caudal branchial plate, and extends back to the limb as a single band."

The number and complexity of the cranial muscles is illustrated by the fact that thirty-eight pages are required merely for a list of the synonyms used by different writers for individual muscles, a list which the author states is "far from complete". This section is notable, not only from the wide range of vertebrate forms, but also from the number of embryos at different stages of development which he has examined. Its value is enhanced by the number of illustrations given in corroboration of the facts stated in the text.

The author discusses at length some of the difficulties which arise in determining muscle homologies. The segment of origin of homologous muscles is in general constant from genus to genus and from phylum to phylum, but exceptions occur. Anatomists have long been accustomed to consider that the nerve supply to a muscle affords sound and reliable evidence of its homology, and this is generally the case, but again exceptions occur; the muscle plate of the mandibular segment is as a rule innervated by the fifth nerve, but in certain instances the seventh nerve may be the source of nerve supply, and this arises, according to the author, from the shortness of the first gill cleft.

The author has dealt more fully than is usual with the relation of nerve to muscle and not only with the peripheral pathway through which muscles are innervated, but also with the significance and the homologies of the groups of motor cells, spinal and medullary, from which the nerves are derived. Experimental evidence is made use of whenever possible to determine afferent from efferent fibres in different nerves, and a chapter is devoted to analysis of the groups of efferent cells in the "occipito-spinal motor cell column".

The aim of the author has been to ascertain what evidence the study of these muscles gives on the problem of the genetic relation of the vertebrate phyla "and so of the phylogenetic history of Man in the remote past". It may perhaps be doubted whether the material which he uses is capable of affording such information. The successive changes undergone by the developing embryo and its parts give only a general indication of phylogenetic history. The skeleton, the central nervous system and many of the viscera have been studied from this point of view, but have yielded no information of great significance on this problem. Where these systems have failed, it is scarcely to be expected that the study of muscles would be more fruitful, but the author's studies have led him to certain conclusions as to what were the characters of the ancestral forms from which the existing vertebrate phyla have originated, and these are given in detail in the final chapter.

No one who works, as the author has done, on broad problems of morphology can fail to have his interest excited in the significance of the whole embryological process and the variations in its details which occur in different forms. The author's

attitude towards this problem is best expressed by some sentences which may be quoted :

"The development of the cranial muscles gives much evidence of its purposeful character."

"In some unknown way the growing organism appears to foresee future needs, and sets to work with such material as it has to develop the necessary structures along the lines followed by its ancestors".

"Experimental embryology shows that the growing organism from the zygote upwards is a whole and not merely an aggregate of parts. Similarly, animals are psychological units, characterised by *memory and purpose, by striving* after ends in view. The variations in the development of homologous structures and in the structures by which the same functions are carried out show that this psychological factor is of great importance from the first."

"This immaterial, non-spatial, teleological factor, the mind, can initiate and inhibit physico-chemical processes. Life, development of individual organisms and evolution are primarily due to this power."

In view of the size and form of this volume and the wealth of illustrations—there are 841 figures, clearly drawn and reproduced on special paper, pp. 301–493—the price cannot be considered unduly high, though it may restrict its circulation. It is indispensable to workers in vertebrate morphology, and the author deserves the highest commendation for the care, the skill and the wide range of his inquiries, and is to be congratulated on the completion of a work which is a credit to British zoology.

DAVID WATERSTON.

# A Study of the Ephemeroptera

**The Biology of Mayflies:**
with a Systematic Account of North American Species. By Prof. James G. Needham, Dr. Jay R. Traver, Prof. Yin-Chi Hsu, assisted by Specialists in certain Subjects. Pp. xvi+759. (Ithaca, N.Y.: Comstock Publishing Co., Inc., 1935.) 7.50 dollars.

PROF. JAMES G. NEEDHAM, of Cornell University, the senior author of this book, has made a very valuable contribution to the knowledge of a little-known order, the Ephemeroptera. This biology has one outstanding feature of merit, it is original work. Prof. Needham has gathered around him a band of enthusiastic workers who have come forward and in their own words and under their own names, have told us of the results of their researches. Two of these workers appear with Prof. Needham as joint authors. The second author, Dr. J. R. Traver, has been responsible for nearly the whole of Part 2, the systematic description of the North American species, about five hundred pages, as well as a portion of Part I dealing with life-history and collecting. The third author, Prof. Yin-Chi Hsu, is responsible mainly for the chapters dealing with structure and anatomy. There are further chapters on anatomy under the pen of Dr. V. Knox.

This book is perhaps the most comprehensive that has ever been undertaken on the biology of the order. Pictet, in 1843, dealt with both anatomy and systematics in his "Histoire des Névroptères"; Eaton's classic monograph on "Recent Ephemeridæ" was mainly systematic; there have been sundry papers written by various authors since 1888, the date of Eaton's great work, scattered through entomological literature.

Prof. Needham's book will appeal, of course, mainly to the specialist, having regard to the fact that so large a proportion of its space is devoted to American systematic work; but the biology proper, consisting as it does of no less than 236 pages, has an interest not only for entomological workers but is also of economic value to all who are concerned with the study of the food of fishes, in Great Britain, more particularly the trout.

Chapter i deals with the life and habits of the Ephemeroptera or, as they are perhaps unfortunately called in America, the mayflies. It is unfortunate because the title is misleading. Not only do these insects appear on the wing during every month of the year—at least they do so in Great Britain—but also the name mayfly in the fly-fisher's world is restricted in its application to species of *Ephemera*, and the fly-fisher's popular nomenclature may be traced back for nearly five hundred years.

While, generally speaking, the life of an ephemeropteron is not quite so ephemeral as the name would suggest, Prof. Needham tells us of a species, *Callibœtis fluctuans*, the entire life of which in the winged condition is restricted to some forty-eight hours, during which it emerges from the water, changes from the subimago to the imago stage, pairs, oviposits and finally dies. The mayfly proper, the British species, *Ephemera vulgata*, on the other hand, has been observed by the writer, at least two months after emergence, having been so long on the wing as to have darkened to nearly black.

America is a country of extremes, and this trite saying applies even to the Ephemeroptera, for we read here that instances have been recorded of

these little insects swarming in such incredible numbers that camp fires have been extinguished beneath their corpses.

Several pages are devoted to the nymphal stages and then we come to Prof. Hsu's chapters on structure; not only are the external parts explained but the internal anatomy as well, with a final word which carries us through the insect's development moult by moult.

Dr. O. R. Smith contributes a chapter on the eggs and methods of oviposition. We learn that the females habitually fly against the breeze in order to maintain their position over a selected portion of the water: that some get rid of their eggs a few at a time, dipping over the surface; others drop them in a mass; and that others again crawl down under water and lay their eggs on stones and rocks.

Passing to Chapter xvi, we find some useful information on the economic value of the Ephemeroptera; then there is a chapter on collecting, preserving and rearing them in captivity, and finally we come to Part 2, which deals with systematics. It suffices to state with regard to this branch of the subject, that the known North American species number 507 grouped in 3 families, 17 subfamilies and 47 genera. Useful keys and tables are included, and the whole plan of this part has been extremely well constructed.

We have no hesitation in stating that this book is a very fine contribution indeed to entomological literature. MARTIN E. MOSELY.

# Developments in Organic Chemistry

**(1) Physical Aspects of Organic Chemistry**
By Dr. W. A. Waters. Pp. xv+501. (London: George Routledge and Sons, Ltd., 1935.) 25*s*. net.

**(2) The Chemistry of Natural Products related to Phenanthrene**
By Prof. L. F. Fieser. Pp. xii+368. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 32*s*. 6*d*. net.

**(3) Reactions of Organic Compounds**
By Dr. W. J. Hickinbottom. Pp. x+449. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 16*s*. net.

(1) A TREATISE on the implications to organic chemistry of new conceptions of the atom is particularly valuable at this stage when the arbitrary ideas of the chemist have been largely justified. Electro- and co-valencies, and the semi-polar bond are now universally recognized, and the complex hypotheses of induced polarity and conjugation are receiving physical interpretation.

Just as the existence of polar and non-polar bonds has been admitted, it is now certain that both ionic and non-ionic reactions occur in organic chemistry. The latter resemble photochemical reactions, and include those like the pyrolysis of diazoamines, in which transient formation of free uncharged radicals must occur. Greater space is devoted to ionic reactions, which are induced by polar reagents, and generally involve carbonium anions and cations. Thus the properties of free radicals, which behave variously as non-polar radicals, or as cations, or as anions, receive an explanation. Molecular rearrangements result from the reconstruction of a carbonium cation, caused by an ionic reagent.

In dynamic isomerism, which involves an equilibrium between two forms, an ion wanders from one part of a molecule to another (prototropy or anionotropy) with consequent redistribution of valency bonds. The classical idea of tautomerism, that a single substance can react as if it had two structures, is revived in terms of wave-mechanical resonance, to which brief reference is made. The two structures differ only in electronic arrangement, neither representing the molecule, "but a hybrid intermediate between them, which cannot be represented by ordinary symbols, and has to some extent the properties of both" (Sidgwick). Conjugation and aromatic properties are discussed chiefly in terms of the theories of Ingold and Robinson, according to which an electromeric change may be induced in an aromatic derivative giving an activated molecule, the polarization of which determines further substitution.

The value of the book to students is enhanced by the use of the historical method of approach. In the more physical chapters, such as that on dipole moments, mathematical treatment is curtailed, but conclusions important to chemists are concisely stated.

(2) Structures containing polynuclear ring-systems based on the hydrogenated phenanthrene nucleus have been allotted to the morphine alkaloids, the sterols, sex-hormones and cardiac poisons. The dramatic manner of progress lends added interest to this monograph, which is a comprehensive interim report (the copious references include January 1936, and 70 per cent date from 1930) on a subject important alike to chemists and physiologists.

An account of the chemistry of phenanthrene itself is followed by a lucid treatment of the

morphine alkaloids and resin acids, which deals with their genetic relationships, their phytosyntheses, and the problem of drug addiction. Throughout, relevant features of general or biological interest are described, so that the complex chemical side is put in its correct perspective. This is exemplified in the account of the cancer-producing hydrocarbons, which though not yet known as natural products are related to the latter, and generally contain a phenanthrene ring-system. That methylcholanthrene, the most powerful carcinogenic agent known, is a bile-acid degradation product has obvious significance, and points to metabolic derangement as a natural prelude to cancer.

Although Windaus and Wieland had seemingly settled the structure of the sterols, in 1932 Rosenheim and King, guided by the results of X-ray crystallography and by an observation of Diels, suggested an improved formulation. Since then organic chemists have not looked back, and the story of the elucidation of the structures of the sterols, bile-acids and sex-hormones forms the most fascinating part of the book. The cardiac poisons and the saponins are yielding their secrets too, and are already known to possess the same polynuclear system as the sterols, which has the most diverse distribution in Nature, and may fulfil the most manifold functions. Structures chemically similar have such different physiological properties as those of vitamin D, the sex-hormones, and the cardiac poisons!

The book may be recommended to all chemists interested in the subject; the author, who has himself made worthy contributions, deals impartially with the work of many investigators in many lands, and frequently interpolates his own valuable suggestions where finality is still lacking.

(3) This text-book presents organic chemistry in a way making for closer liaison between theory and laboratory practice, but is recommended also as a reference book, not least for the large number of well-chosen references. Compounds are treated according to functional groups in eleven chapters, each of which has a summary and descriptive tables; reactions are dealt with fully, and a number of representative preparations is included.

Within the limits imposed by the author (for example, heterocyclic compounds and condensed nuclei are only referred to incidentally) the work is reasonably complete. The section on diazonium compounds might have included Nesmejanov's work on mercurials, and that on halogen compounds recent patent literature on sodium alkyls and aryls. On the other hand, the influence of structural factors, polar or steric, on the course of well-known reactions is usefully treated.

With journals so drastically abridged that reactions are referred to only by the names of their discoverers, the author might have named them so; and the absence of an author index makes it difficult to look up less-known reactions. Textual errors are rare, and generally of a minor nature. For the amount of information it contains, the book is low priced, and should prove invaluable to the student as a manual of organic reactions, and an aid in the identification of carbon compounds.

# Mysore Tribes and Castes

**The Mysore Tribes and Castes**
By Diwan Bahadur L. K. Ananthakrishna Iyer. (Published under the auspices of the Mysore University.) Vol. 1. Pp. lxxii+502+68 plates. (Mysore: Government Oriental Library, 1935.) 15 rupees; *24s.*

A PERIOD of more than thirty years has elapsed since the late Mr. Nanjundayya commenced a systematic survey of the tribes and castes of Mysore on the lines laid down by a former Census Commissioner for India, the late Sir Herbert Risley. In 1925, Mr. Ananthakrishna Iyer succeeded the original superintendent of the Mysore Survey. Three volumes have already appeared containing the Survey results, caste by caste, in alphabetical order; and we now welcome the appearance of vol. 1, which deals with the results as a whole.

It is not unusual for the authors of such works to invite a distinguished scholar to add a short introduction to his general volume; but Mr. Ananthakrishna has thought fit to enlist for this purpose the assistance of several well-known anthropologists, so that his book becomes more a compendium of essays than the mature conclusions of one writer. Thus, Dr. R. R. Marett commences with a short appreciation of the book, and some interesting reflections on the parts which East and West may profitably play in such inquiries. The late distinguished scholar, M. Sylvain Lévi, follows with some general remarks on the nature of caste. These are followed by a translation for use in India.

We then come to a lengthy and most important essay by Baron von Eickstedt, of Breslau. This is perhaps the most important feature of the book. Von Eickstedt, dealing in some detail with the

racial invasions of India in the past, and after allotting due influence to occupation and environment, presents the reader with an entirely novel classification of the population, for which he supplies some anthropometrical data. It will be remembered that most former writers on Indian racial elements have been disposed to assume an original Kolarian population of a very early type, displaced later, largely in the south, by a Dravidian immigration, upon which followed the arrival from the north-west passes of an Aryan-speaking people. Later bands of immigrants, such as the Scythians, Yuechi, and Huns, penetrated northern and western India between 100 B.C. and A.D. 600. Von Eickstedt, rejecting the existing terminology as savouring too much of linguistic instead of racial significance, evolves a threefold base for the Mysore population, namely, the Veddids, the Melanids, and the Indids. To each of these he allots sub-groups. A table giving anthropometric data for these will be found on p. 76.

The reader must be left to study for himself the exact significance of these new divisions. It is possible to convey a rough idea of them by explaining that the Veddids have much in common with the old Kolarian, the Melanids seem to be similar to Dravidian, and there is little to distinguish the Indid from the Aryan. In the special Ethnographic Appendix to the last Census of India, some doubt is thrown on the value of von Eickstedt's classification owing to the inadequacy of the anthropometric data on which it rests. It is, however, one that will repay careful examination; and it certainly possesses the merit of simplicity when compared with the almost incomprehensible formulæ of 'co-efficients of relative likeness' on which Dr. Guha proceeds in the Census of India volume.

Not content with the assistance of the three scholars referred to above, the compiler of this volume next offers the reader a chapter on the cultural geography of Mysore by a distinguished member of the Indian Civil Service, Mr. F. J. Richards. Writing with personal knowledge of the country, Mr. Richards gives us a thoughtful study of the history and cultural features of the population of Mysore which by itself would make Mr. Ananthakrishna's book a valuable possession. Interesting charts are added, showing the extent and distribution of various elements in the population, such as Marāthas Lingāyats and Jains. From these it can be learned by a rapid glance how the main castes and tribes are distributed throughout the State territories.

Following these more or less introductory essays, the reader will find chapters on caste, religion, taste in dress and ornaments, totemism, magic, animism, etc.; and here we meet for the first time with an attempted summary of the various contents of the articles in the preceding volumes. The writer's survey takes him far afield; and we are even given specimens of the particular tattoo marks favoured by Hindu ladies, such as a picture of the temple of the god Shiva, accompanied by his attendant *Nandibail* (p. 438). Space does not, unfortunately, admit of a study of the significance of this material. A few words must, however, be devoted to the important Chapter vii, which deals with the practice of totemism.

Some recent investigations in the neighbouring Presidency of Bombay concerned with the same subject have tended to show that more prospect exists of arriving at the origin of the population by having regard to the practices of the people in this connexion rather than by measuring their heads and their noses. In the pages of the *Indian Antiquary* (**61**, 106–111; 1932) a list of some two hundred and twenty totem divisions identified in the centre and south of the Bombay Presidency will be found, and will repay most careful study. On p. 255, Mr. Ananthakrishna gives a list of a hundred and twenty-five such totems, which are classified as animals, trees and plants, and inanimate objects. Needless to say, the resemblance to the Bombay list is striking, the entries in many cases being identical. As was to be expected, the author of this work finds the system in many cases to be in a state of decadence; but it is none the less widespread among tribes and castes of non-Aryan origin. He shows that customs such as matriarchy, adult marriage, burial and totemism are a surer guide to the racial origin of a caste or tribe than most of the traditional accounts which are so readily forthcoming to mislead the investigator.

The chapters on animism and magic contain little that has not already been recorded in other works on the subject. On p. 237 *et seq.* reference is made to the curious custom known as the *couvade*. Mr. Rice, in the *Mysore Gazetteer*, has already supplied evidence of confinement restrictions on the husband among the Kuravas. Little fresh material can be gathered from the present volume.

In conclusion, it remains to congratulate Mr. Ananthakrishna Iyer on the completion of his great task. The separate and final volume promised by him, which is to contain a bibliography and index, will be awaited in the hope that it may also find place for the missing synonyms of caste and tribal names which the previous three volumes should have included. The present work is signally free from misprints, though it may be observed that 'ironette' (p. 473) as a kind of dancing seems a somewhat novel form of movement. Are we really dealing with a 'pirouette'? There are numerous excellent illustrations.

R. E. ENTHOVEN.

**The Land of Britain:**
the Report of the Land Utilisation Survey of Britain. Edited by Dr. L. Dudley Stamp. Part 78: Berkshire. By J. Stephenson, with an Historical Section by W. G. East. Pp. 113. (London: London Utilisation Survey of Britain, 1936.) 2*s*. 6*d*.

THE publication of the first of the contemplated eighty-seven county reports on the utilization of the land of Great Britain gives an idea of the scope and value of the work. The report begins with a summary of the geographical background, geology, relief, soils and climate. Then follow accounts of the distribution of woodland, arable land and grassland, which are closely correlated with physical conditions and illustrated with distributional maps. Next comes the distribution of orchards and poultry farming and lastly the distribution of settlements and population in general.

The report brings out not merely the present use of the land but also indicates the changes that have taken place chiefly through the operation of economic factors. Thus to-day the arable land of Berkshire covers 26·5 per cent of the county, while in 1808, and for many years subsequent, it appears to have covered more than fifty per cent. The process of putting arable land down to grass is still continuing. On the other hand, arable farming would appear to be concentrating in the areas best suited to that use. This tendency is accentuated by better transport, which helps to nullify advantage of position, and uniform wages which reduce the ability of poor areas with low wages to compete with better land. Mr. Stephenson concludes by dividing the county into agricultural regions each with its own characteristics and potentialities, and he notes that Berkshire is in a transitional stage common to all counties near London. Price conditions are changing the aspects of farming, and growth of population and transport are making the east and south more and more into residential areas.

The report concludes with a valuable article by Mr. W. G. East on the utilization of the land about 1800.

**Wild Flowers of the Wayside and Woodland**
Compiled by T. H. Scott and W. J. Stokoe, based upon the Standard Work "Wayside and Woodland Blossoms" by Edward Step. Pp. 352+81 plates. (London and New York: Frederick Warne and Co., Ltd., 1936.) 7*s*. 6*d*. net.

THIS attractive book will prove very useful to the field naturalist rather than to the academic student of systematics. It is well produced, and is of a size convenient for the pocket. Such a book, well printed and beautifully illustrated, is just that type which helps the intelligent man to a truer appreciation of the country, while at the same time giving a valuable insight into the beauties of Nature. It should, therefore, give full satisfaction to the country rambler interested, if only mildly, in the surrounding flora. Apart from this, however, it will provide an excellent introduction to a later more serious study of systematic botany.

The book opens with a short description of the more common forms of leaves, and this is illustrated by two pages of line diagrams. Next follows a short dissertation on the forms of flowers, illustrated by a typical flower and line diagrams of the more common types of inflorescences. A short glossary of botanical terms helps the reader to follow more easily the descriptions in the greater part of the book.

An unusual and helpful feature then follows: forty pages are devoted to line diagrams of common flowers, grouped according to the colours, white or whitish, and shades of pink, red, yellow, blue, purple, lilac, green and brown.

The bulk of the book is occupied by a description of the most common plants in the British flora. This occupies about 250 pages, interspersed with eighty coloured plates each portraying about four types of flowers. There is an index.

This book is to be unreservedly recommended, and, in view of the amount of subject matter and coloured illustrations which it contains, it is excellent value for the price demanded.

**The Heavens and Faith**
By the Rev. M. Davidson. Pp. xv+162. (London: Watts and Co., 1936.) 5*s*. net.

THE impact of the science of astronomy upon the Christian faith is a topic which has been dealt with by a number of writers, but Dr. Davidson is better equipped than many, because he is at once a clergyman and an astronomer, Sir Frank Dyson testifying in a foreword to his competence in this science. But, what is not less important, Dr. Davidson has not only the requisite knowledge, but also the necessary candour, apart from which all discussion ends with foregone conclusions.

The problems set for religious faith by modern astronomy are threefold: (1) the apparent indifference of an incredibly vast universe to man and his destiny; (2) how to reconcile the three-storey universe of Creeds and Scripture with present scientific knowledge; and finally (3) what we are to make of the eschatological beliefs entertained not only by Paul and the primitive Church, but also, as is now recognized by scholars, by the Founder of Christianity himself. Most works of orthodox apologetic tackle (1) and (2) with varying degrees of success, but there is a widespread tendency to ignore (3) altogether, in spite of its vital importance. Dr. Davidson, however, does not evade this issue, nor seek to obscure the point that the ethic of the Sermon on the Mount had a very definite basis of apocalyptic belief which is no longer held. How far its validity may be thereby affected is a matter for serious inquiry and not for dogmatic assertions. As a matter of fact, if we believe that the world is soon to end and be replaced by a better, the ethic of the Sermon is mere common-sense, and not fantastic idealism, as it appears to most 'world-accepting' citizens to-day.

This book was very well worth writing, and will repay study. J. C. H.

**Out of the Night:**
a Biologist's View of the Future. By Prof. H. J. Muller. Pp. 127. (New York: The Vanguard Press, 1935.) 1.50 dollars. Pp. 160. (London: Victor Gollancz, Ltd., 1936.) 4*s*. 6*d*. net.

EUGENICS is based very largely on genetics, and any technical or theoretical advance in the latter science has its effect on eugenical thought. Consequently, the considered views of Prof. Muller, well known as one of the leading geneticists of the day, on eugenical topics are very welcome.

Prof. Muller commences with a consideration of the evolution of man, illustrating his argument with novel and effective analogy. He then discusses the future of man and contrasts man's probable fate if conscious control of the occurrence of various genetical types is not exercised, with his possible achievements if such a control is successfully attempted.

The author next considers the measures which seem desirable for the purpose of such a control of genetical change in man. He favours the extensive use of a few chosen sires, by a technique involving the storage of gametes and artificial insemination. It is important to note that technically many of the proposals made are either possible at present or likely to be rendered possible by a relatively small amount of further research.

It is certain that Prof. Muller's views on the technique of human improvement will not be universally accepted. Some geneticists do not agree that the use of a few chosen sires is the best way of achieving rapid selection. It can be stated, however, that, in spite of possible disagreement on some points, the book will be of great interest to anyone concerned with the problems of eugenics, as it is both genetically and technically accurate.

K. MATHER.

**L'Année psychologique**
Fondateurs: Henry Beaunis et Alfred Binet. Publiée par Prof. Henri Piéron. (Bibliothèque de Philosophie contemporaine.) Année 35 (1934). Vol. 1. Pp. xix+480. Vol. 2. Pp. 481–912. (Paris: Félix Alcan, 1935.) 120 francs.

THIS excellent annual publication becomes more and more an indispensable aid to the study of the ever-increasing production of works and memoirs on psychology. The research value of the "Année Psychologique" is shown not only in its original memoirs, but also and mainly in the useful classification and summary reviews of the current literature concerning psychology published during the year. Among the original memoirs published in the present issue, we should mention H. Piéron's "L'Evanouissement de la sensation lumineuse" and the two essays on psychological factors by N. Margineanu. The classification of the works reviewed occupies fourteen pages of the table of contents; which shows the reviewer's difficulty in making a satisfactory selection, and also the wealth of material which has been sifted and analysed by the editors of this important publication.

T. G.

**The Monks of Athos**
By Prof. R. M. Dawkins. Pp. 408+6 plates. (London: George Allen and Unwin, Ltd., 1936.) 15*s*. net.

PROF. DAWKINS, whose knowledge of the eastern Mediterranean now extends over more than thirty years, has long been known to students not only as an archæologist, but also as a diligent collector of the folk-lore and legends current, or recently current, among the modern Greeks of the mainland and the islands. In the course of four visits to Athos, he has made a gathering of the legends current among the members of the remarkable monastic communities of the peninsula, to which he has added a gleaning from the literature relating to it. His purpose, however, has been inspired by a deeper motive than that of collection merely: his aim has been to test the value of folk-memory as preserved in these legends—a purpose for which Athos is better fitted than most localities. It is somewhat remarkable to find that, in communities which are notoriously anti-feminine, the Virgin Mary holds a place no less prominent than in other parts of the Mediterranean. It is also to be noted, the author points out, that theological controversy, which has raged here on more than one occasion, appears to have been forgotten almost immediately after settlement, and has left little or no mark on tradition.

Prof. Dawkins found that his main purpose would have been very inadequately served without some account of the geographical and cultural setting. In consequence, he has written a full description of the peninsula, which conveys its charm in a literary style no less felicitous than the subject matter demands.

**Geologie von Asien**
Von Prof. Dr. Kurt Leuchs. Band 1, Teil 1: Überblick über Asien, Nordasien. (Geologie der Erde, herausgegeben von Prof. Dr. Erich Krenkel.) Pp. viii+236. (Berlin: Gebrüder Borntraeger, 1935.) 18.40 gold marks.

THIS addition to the "Geologie der Erde" series, published under the general editorship of Prof. E. Krenkel, is planned to comprise two volumes each of two parts, and, in its completed form, will fill a long-felt want in geological literature.

The first part of vol. 1 contains a general introduction including a summary of the physiography and geological structure of Asia as a whole. This is followed by the section dealing with north Asia, which includes a relatively detailed discussion of the stratigraphy and igneous rocks, the tectonic structure and the chief ore deposits of the region.

To some extent it covers the same ground as Obrutschew's "Geologie von Sibirien", published in 1925; but in the intervening years much new material has become available and is incorporated by Prof. Leuchs.

The chief value of this book lies undoubtedly in the fact that it summarizes and makes available a great body of obscure, and for all practical purposes, inaccessible Russian publications, and as such is a notable addition to geological literature.

# Seventh International Congress of Refrigeration

By Dr. Ezer Griffiths, F.R.S.

THE Seventh International Congress of Refrigeration, organized by L'Institut International du Froid and the Netherlands Association of Refrigeration, opened at The Hague on June 16 and closed at Amsterdam on June 20. For the opening ceremony, about four hundred members of the Congress, including delegates of fifty nations and members of the Dutch Government, assembled at the historic Ridderzaal—the Hall of the Knights at The Hague. At this meeting, speeches of welcome were made by representatives of the Dutch Government and such preliminaries settled as the appointment of presidents and secretaries of sections, together with the procedure to be followed in the conduct of the meetings.

The work of the Congress was subdivided between four sections, and altogether about two hundred papers and reports came under consideration. Abstracts of the papers were printed in the language supplied, followed by translations in French and (or) English. The topics of these papers covered the whole field of low temperature work, and were of a varied character, ranging from paramagnetism to a new method of making ice rinks. The mass of material to be dealt with proved embarrassing, since in the limited time available full discussion was impossible.

There was a feeling that a more rigid process of selection would need to be followed in preparing the programme of the next Congress. In a congress of this character, adequate time for discussion is all-important, for sometimes ancillary information of considerable interest is brought out in the course of a discussion. For example, a paper was read describing the development of refrigeration in Japan; and, in answer to a question, an outline was given of the method employed in certain parts of that country for the cultivation of strawberries—a subject of general interest. A sunny slope is selected exposed to sea-breezes. The rocks are arranged with pockets of earth between, and in these the roots of the strawberry plant are planted. At night the rocks cool and condense water vapour which trickles down the rocks and is absorbed by the earth. By day the rocks warm up rapidly and afford a source of heat to the strawberry plant.

The majority of the papers dealt with that aspect of low temperature work which is concerned with methods for the preservation of perishable foodstuffs. The papers read at this Congress would perhaps suggest that the engineer is greatly in advance of the biologist in the science of refrigeration, but this impression is probably due to the fact that biological workers as a whole failed to support the Congress to the same degree as their engineering colleagues. Much of the biological work recorded was more of a descriptive character than an attempt to get down to fundamentals as regards the chemical and structural changes taking place consequent on storage temperature and environments. There is great scope for investigation on the biological side, particularly in respect of tropical fruits, and it may be of interest to record that a resolution was passed at this Congress recommending that the question of tropical fruits should occupy a prominent place in the programme of the next Congress; such fruits afford interesting material for research, for it is possible to carry out, in the course of weeks, experiments which may be protracted over many months in the case of hard fruits.

Reverting to the engineering side, it was noteworthy from the papers submitted to the Congress that advances are being made in the production of temperatures considerably lower than those customary in cold-stores work, although of course much higher than liquid air temperatures. Here the question is not one of the mere attainment of low temperatures, but the economical production of temperatures of the order of $-50°$ C. in large spaces. For example, ice-cream manufacturers prefer quick hardening of their product in wind tunnels at $-40°$ to $-50°$ C. to slow hardening at a higher temperature.

These developments in refrigeration have resulted in the evolution of special types of refrigerating machinery. For intermediate temperatures of, say, $-25°$ to $-40°$ C. the booster compressor of the rotary blower or piston type finds application in raising the pressure of low density vapour to densities at which it can be efficiently handled by compressors of standard design. Lower temperatures are obtainable by refrigerating equipment of the modern absorption type, in which temperatures so low as $-76°$ C. can be economically obtained in commercial practice, using ammonia, in spite of that temperature being within one degree of the triple point of ammonia and the specific volume being twenty-five to thirty times as great as at ice-making temperatures.

The question may reasonably be asked what useful purpose does such a Congress serve. In the first place, it affords unique opportunity for workers in various countries to establish contact

and exchange views, and on this occasion the various nationalities came together with a common objective. Representatives from the Dominions Overseas appreciated to the full the value of the Congress as an opportunity to meet their colleagues. The Congress also demonstrated to those countries which are lagging behind in the encouragement of scientific work the benefits accruing from organized research.

During the period of the Congress, meetings of some of the commissions functioning under the auspices of the Institut International du Froid were convened. Commission No. 1 considered the question of temperature measurements down to liquid hydrogen temperatures. The temperature scale is defined by international agreement down to the boiling point of oxygen; beyond this there is no generally accepted standard scale. Even in the range covered by the International Scale, further work appears to be necessary, since some investigators have found that platinum thermometers constructed and calibrated according to specification differ by so much as 0·03° at about – 140° C. To study this question, it was decided to set up a committee composed of representatives of the various national laboratories and of those centres where low temperature investigations are in progress.

Commission No. 12 on land transport and Commission No. 13 on water transport held a joint session. As problems for further study, they decided that data should be collected as to the heat production of various types of fruit, this being a matter of interest to the marine engineer when dealing with fruit delivered to the ship without pre-cooling. It was also decided to consider methods for the control of the atmospheric conditions in the holds of ships carrying perishable produce requiring atmospheres of high carbon dioxide and low oxygen content.

These are subjects which will be studied by expert committees under the auspices of the Institut International du Froid and reported upon at the next Congress.

Thanks to the thorough planning of the executive committee, the arrangements worked smoothly and efficiently, and those participating will retain the most pleasant memories of a very useful meeting.

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# The Royal Research Ship *Research*

By Dr. H. Spencer Jones, F.R.S., Astronomer Royal

THE destruction of the non-magnetic ship *Carnegie* by an explosion, at Apia, Western Samoa, on November 29, 1929, brought to a sudden end the magnetic survey of the oceanic areas, which had been carried on for twenty-five years by the Carnegie Institution of Washington. The *Carnegie* had been specially designed and constructed for obtaining magnetic observations at sea. She was a hermaphrodite brig, built of white oak and pine, with copper or bronze fastenings, and with a displacement of 568 tons. She was equipped with an auxiliary engine, capable of giving a speed of about 6 knots in calm weather; the engine was of internal combustion type and, at first, used gas generated from solid fuel, but, as this proved not altogether satisfactory, petrol was substituted. Sufficient fuel was carried to give a cruising range of 2,000 miles at 6 knots. With the exception of cast-iron pistons for the cylinders of the engine and the steel cams necessary for operating the valves, amounting in all to less than 600 lb., no magnetic material was used in the construction of the ship.

In six cruises between 1909 and 1921, the *Carnegie* traversed 252,702 miles in 3,267 days actually at sea. Her last cruise was planned to extend from May 1928 to September 1931 and to cover 110,000 miles. It was designed to determine the secular change of the earth's magnetism in all oceans, by making numerous intersections with the tracks of previous cruises. Nearly one half of this cruise had been completed at the time of her loss.

The results obtained by the *Carnegie* were placed freely and promptly by the Carnegie Institution at the disposal of the British and other Governments, for use in the construction of world magnetic charts. Successive issues of these charts were based to an increasing extent upon the data provided by the *Carnegie*.

The secular changes of the magnetic elements at any given place are not constant quantities. Extrapolation over long periods may therefore lead to considerable errors. The continual accumulation of observations is necessary in order to determine both the secular change and the rate of change of the secular change of each element. At the present time, the magnetic data are most uncertain in the Indian Ocean. The last cruise of the *Carnegie* in the Indian Ocean was in the year 1919. The

cruise on which she was engaged at the time of her destruction was to have taken her into the Indian Ocean in 1930 and 1931. In South Africa there has been a considerable decrease within recent years in the secular change of the magnetic declination, and in Western Australia there has been a considerable increase. There are no data available as to how the secular change is altering in the southern Indian Ocean between South Africa and Australia. The magnetic charts for this area are therefore based at present upon very uncertain extrapolations. In other areas, where the magnetic elements are known at present with reasonable accuracy, the extrapolated values would become less and less reliable in the course of time, in the absence of further observations, such as were provided by the *Carnegie*, to serve as a control on the changes in the secular variations.

In view of the fact that Great Britain is the principal maritime nation, the British Government has accepted the responsibility of providing accurate magnetic data at sea, and a non-magnetic ship is to be built, equipped and operated for this purpose by the Admiralty. The ship is to be known as the Royal Research Ship *Research* (R.R.S. *Research*), and she will fly the Blue Ensign and Jack with the yellow Admiralty anchor in the fly.

The plans for the new ship have been prepared at the Admiralty and it is hoped that the construction will be commenced shortly. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington not only placed at the disposal of the Admiralty all information with regard to the construction and the instrumental and other equipment of the *Carnegie*, but also generously gave the services of Mr. W. J. Peters as consultant, without charge. The experience and advice of Mr. Peters, who commanded the *Carnegie* on her first two cruises, have been of the greatest value in the design of the ship and of her equipment.

The R.R.S. *Research* will be somewhat larger than the *Carnegie*. She will have a displacement of 650 tons and will be brigantine rigged. She will be provided with a single screw Diesel engine and will carry sufficient oil fuel to give a radius of action of about 2,000 miles at 6 knots. Her cables will be of bronze, instead of the hemp rope used in the *Carnegie*, and to some extent brass or bronze will take the place of wood. She will carry a total complement of 31, including the commanding officer, three deck officers, three scientific workers, a surgeon (who will also be a scientist) and an engineer.

The work of the R.R.S. *Research* will not be restricted solely to magnetic observations. She will undertake observations of atmospheric electricity. Such observations are particularly valuable at sea, where the air is less contaminated by suspended impurity than it is on land. It may be recalled that it was by means of observations on the *Carnegie* that it was established that the maximum potential gradients are related to Universal Time and not to the local time of the place of observation. The *Research* will be provided with an oceanographic winch and motor for oceanographic work, will carry an echo depth sounding gear, and will also make meteorological observations, including upper air observations by means of pilot balloons.

The principal magnetic instruments for observations at sea will be a marine collimating compass for observations of declination ; a sea-deflector, for observations of the horizontal intensity ; and a marine dip inductor for observation of the dip. The collimating compass is a modification of the standard marine liquid compass. The magnet system carries four concave speculum mirrors, adjusted so that their optical axes are in the direction of the four cardinal compass points. A scale is mounted in the focus of each mirror. The four scales are carried on arms attached to the magnet system. The angle between the sun, when at low altitude, and one or other of the four compass points, as defined by the scale images, is measured with a sextant, the scales being viewed through windows in the compass bowl. This observation provides the means of calculating the magnetic declination. The compass will be mounted in such a position that it will have as clear a view of the horizon as possible.

The sea deflector consists of a marine compass, provided with permanent attachments, whereby a deflecting magnet can be mounted in a horizontal position and vertically above or below the compass magnet system. The bowl is rotated until the deflecting magnet is perpendicular to the compass magnet, as shown by the reading of the card. The angle of deflection is read on a graduated scale on the edge of the bowl. The deflector is mounted in an observatory adjacent to, and forward from, the chart room, in which is the standard compass. As the observer at the deflector reads off the angle of deflection, a second observer at the standard compass reads off the direction of the ship's head. The horizontal intensity is proportional to the cosecant of the deflection. The constant of proportionality is determined periodically by simultaneous observations ashore, with the sea deflector and land magnetometer.

The marine earth-inductor follows the general design of earth-inductors, but is provided with a special gimbal stand that is not affected by the rotation of the coils. It is important, for observations

at sea, that it should be driven at a constant speed, and a special tuning-fork controlled rotary converter, situated in the after part of the vessel and driving through an articulated phosphor-bronze shaft, will be provided to ensure this. Two galvanometers, one of the moving coil type, with short period, and the other of the string type will be provided and experience will be gained at sea of the relative suitabilities of the two types. The earth-inductor will be mounted in an after observatory.

Portable instruments for land observations, at fixed magnetic observatories and elsewhere, will also be carried. The designs of the instruments have been based on the Carnegie Institution designs, with such modifications as were suggested by experience on the *Carnegie* or as seemed desirable for various reasons.

The magnetic observations on the R.R.S. *Research* will be made primarily in the interests of navigation. But they will provide at the same time valuable information about the earth's magnetism, which is needed for the investigation of such matters as the non-potential portion of the earth's field and the line integrals around closed contours on the earth's surface.

# Body Orientation of the Lower Crustacea (Branchiopoda)

By John H. Lochhead, University Museum of Zoology, Cambridge

AMONG the Branchiopoda it is now well known that the Anostraca swim normally lying on the back, while the Notostraca swim with the back directed upwards. Orientation is also constant among the Cladocera, but there are here considerable differences between genera.

Four possible controlling factors have been suggested. These are the aeration of the water, gravity, the surface resistance of the animal, and light.

Lowndes[1] and Wertheim[2] hold that the limbs of Anostraca, which are doubtless respiratory, are normally directed upwards because the upper layers of water are best aerated. This view, however, cannot apply to the Notostraca. Nor could orientation be controlled in this way except perhaps very near the water surface, since the differences in aeration above and below a swimming animal must normally be too small to be detected. It is true, however, that both Anostraca and Notostraca often come up and beat their limbs just below the surface film, the Notostraca specially turning over on to their backs for this purpose. It has been widely stated that this occurs especially when the oxygen content of the water is low. It may thus well be a respiratory phenomenon, though Mathias[3] has shown that the oxygen requirements of *Artemia* are surprisingly small. In any event, however, the habit is quite distinct from the more usual swimming of the animals farther below the surface.

Control of orientation by gravity may occur in two ways. There may be automatic control, the centre of gravity of the animal being so placed that a constant attitude tends to be maintained independent of muscular effort. The factor of the resistance offered by the surface shape of the animal to the water may also play a part here. Or there may be nervous control due to the effect of gravity on special sense receptors, the position maintained by the animal being then not necessarily the stable one with respect to the automatic forces just mentioned.

Surface resistance is a factor of special importance in the Cladocera, because of the regular rest pauses which characterize their swimming. But in the Anostraca and Notostraca, considered for the sake of simplicity only when swimming or floating more or less horizontally, the effect of surface resistance on dorso-ventral orientation must be small. R. T. Müller[4], however, has shown that for Anostraca the effect due to the centre of gravity may be important. It has long been known that in water the anostracan body sinks back downwards. This might be due to the position of the centre of gravity, or to surface resistance. Müller showed that it is due to both these factors. He placed both fixed and narcotized *Tanymastix* in sugar solution of the same specific gravity as that of the animals, and found that they then lay floating in the solution back downwards. This could be due only to the position of the centre of gravity. He then raised the specific gravity of the solution until the animals rose up fairly rapidly towards the surface; they did so back upwards, surface resistance overcoming the force exerted by the centre of gravity. Thus when an anostracan sinks in water, both forces tend to keep the back downwards. For the Notostraca, such careful experiments have not been done; but Seifert[5] has shown that a dead *Apus* also sinks in water back downwards. Probably this is due to the same

forces acting together as in the Anostraca. If this is so, then *Apus* normally swims in an unstable position with respect to its centre of gravity, and if gravity plays any role in controlling orientation it must be by acting on sense receptors. But although *Apus* has been histologically well investigated, nothing in the nature of a statocyst has been found.

The effect of light on the dorso-ventral orientation of Anostraca and Notostraca may be very marked. But Müller[4] gives much experimental evidence to show that in the anostracan, *Tanymastix*, the responses occur only when phototropism has been awakened by other stimuli; the possibility that this may also be the case for the Notostraca has not been investigated. Both orders, however, respond to sudden changes in the direction of light, the Anostraca seeming always to try to keep the ventral surface facing the source of light, while Notostraca show the opposite response. This corresponds with the normal swimming positions of these animals when light is coming from above. When illuminated from below the animals turn over, though the fresh-water Anostraca seem to find difficulty in swimming in the unaccustomed and unstable position. Individuals of *Streptocephalus* observed by me repeatedly 'looped the loop' when illuminated from below, swimming slowly ventral side down when at the bottom of the loop and going rapidly, ventral side up, over the top of the loop. *Apus* when illuminated from below swims easily on the back, this being for it, as it is for the Anostraca, the presumably stable position with respect to the centre of gravity. In both Anostraca and Notostraca, control of orientation in respect to light has been shown by Seifert to be effected in the first place solely through the eyes. In the Anostraca he has shown[6] that probably only the lateral eyes are concerned. In the Notostraca he has found[5] the lateral eyes to play the chief part, assisted, however, to a small extent by the median eye.

It may be concluded that, while in fresh-water Anostraca control of orientation by light is probably secondary to that exerted by the centre of gravity, this is apparently not so for the Notostraca. Here the normal swimming position is perhaps in direct response to the direction of light, although the possibility that gravity plays a role is not excluded. Seifert[5] found that *Apus*, in response to a change in the lighting, appeared to turn over more rapidly to the normal position with the back upwards than it did for the reverse change. He also found that when the normal habitat conditions are reversed, by lighting from below and placing a false bottom above, *Apus* does not behave towards this false bottom in the same way that it does towards a true one when the light comes from above. But the tendency for the animal to sink rather spoils the significance of this experiment. Much more interesting should be the behaviour of the animals at night. I have found, in agreement with Müller, that fresh-water Anostraca continue to swim ventral side up at night, this being the stable position with respect to the centre of gravity. But for the Notostraca I have no observations on this point, and I can find only two brief notes by Seifert[5]. He states (p. 403) that animals swimming in the dark show some uncertainty in their orientation, and (p. 414) when allowing themselves to sink down after a period of swimming, do so back downwards. These observations, if they are correct, would seem to show that it is indeed light which controls the normal daytime swimming position of the Notostraca. In fresh-water Anostraca this control is probably more latent, being awakened, according to Müller, only by certain disturbing stimuli.

An interesting confirmation of the probable truth of these general conclusions is contained in the later paper by Seifert[6]. In this paper, Seifert compares a fresh-water anostracan, *Chirocephalus*, with the 'brine-shrimp', *Artemia*. For *Chirocephalus* his results are in close agreement with those of Müller on *Tanymastix*. But he finds that in *Artemia* conditions have been reversed by the nature of the environment. *Artemia* swims on the back like other Anostraca, but Seifert finds that in the strong brine in which it lives, this is actually the unstable position, because its body is tending to rise rather than to sink. Correlated with this presumed instability of the normal swimming position, there is a much more constant orientation of the body with respect to light than has been found in other Anostraca. Probably Seifert would thus divide the Euphyllopoda into those forms which normally swim in a 'stable' position and respond to light only after suitable stimulation, and those forms which swim in an 'unstable' position, maintaining their orientation by a constant response to the direction of light.

Clearly other factors than light and gravity, such for example as the currents set up by the animal, may also play a part. But for the sake of simplicity I have not considered these here; nor have I more than briefly mentioned the Cladocera, because the large amount of work done on this group has already been well reviewed (*cf.* Wagler[7]).

[1] A. G. Lowndes, *Proc. Zool. Soc. Lond.*, p. 1093 (1933).
[2] P. Wertheim, *Zool. Anz.*, 106 (1934).
[3] P. Mathias, *Ann. Sci. nat. Zool.*, (x), 17 (1934).
[4] R. T. Müller, *Z. Biol.*, 69 (1919).
[5] R. Seifert, *Z. vergl. Physiol.*, 11 (1930).
[6] R. Seifert, *Z. vergl. Physiol.*, 16 (1932).
[7] E. Wagler, Branchiopoda, in Kükenthal and Krumbach, "Handbuch der Zoologie" Bd. 3, H.I. (1926–27).

# Obituary

## Mr. A. H. S. Lucas

AUSTRALIAN science loses a notable and versatile votary by the death of Arthur Henry Shakespeare Lucas, on June 9. The son of the Rev. S. Lucas, he was born in 1853 at Stratford-on-Avon and educated at Kingswood School, Bath, and the University of Oxford, where he was an exhibitioner of Balliol College.

Going to Australia as mathematics and science master of Wesley College, Melbourne, in 1883, Lucas later became tutor and natural science lecturer at Trinity, Ormond and Queen's Colleges of the University of Melbourne. From 1893 until 1898 he was headmaster of Newington College, Sydney, after which he joined the Sydney Grammar School as mathematics and science master, and headmaster in 1920. He was also for some time lecturer in physiography at the University of Sydney. Retiring from school work at the end of 1923, he acted for two years as professor of mathematics at the University of Tasmania.

One of the founders of both the Victorian and the New South Wales Naturalists' Societies, Lucas was president of both at different times. In 1907–9 he was president of the Linnean Society of New South Wales, and he was a councillor until his death. For many years he was curator of the Algæ of the Sydney Botanic Gardens, and the last twelve years of his life was devoted to active research and wide collecting of Algæ, from Western Australia to the Barrier Reef, usually spending the summer months—including the last—with his co-adjutors, Mr. and Mrs. Perrin, near Georgetown, Tasmania, in this work. His last paper, "The Marine Algæ of Lord Howe Island", was read at the Linnean Society of New South Wales in June 1935. His "Introduction to Botany", written in conjunction with Prof. Dendy, is a well-known text-book to Australian students. But botany, although his chief love, was but one of many studies. In his teaching life, one learned that his personal pupils in the Senior Public Examinations had won University medals in eleven different subjects—these including all branches of science and mathematics. Besides papers on Australian lizards, in collaboration with the late Dudley Le Souef, he published two books on the animals and on the birds of Australia respectively.

Lucas's passion for acquiring learning led him also into the study of languages. A sound classic and English scholar, he extended his range of modern languages beyond the usual French and German to Italian, Spanish and Russian, by way of holiday pastime. The present writer, spending a summer vacation with him at Twofold Bay, found him reading "Don Quixote" in the original, while during the Great War he was requisitioned to interpret Russian in a law court, in the cause of some Russian refugees. Italian was a necessary concomitant to the study of De Toni's work on Algæ. Far beyond Dr. Johnson's conception of learning, Lucas earned the famous epitaph on Goldsmith "Nihil quod non tetigit; nihil tetigit quod non ornavit".

A great teacher, a humorous and lovable friend, Lucas's wide influence was attested by the large and representative gathering which—at the shortest notice—attended Roseville Church to pay the last honours to a rare personality. He leaves three daughters and three grandchildren. H. J. C.

## Dr. J. D. Unwin

WE regret to record the death of Dr. J. D. Unwin, anthropologist and head of Cambridge House, the University social settlement in south London, which took place after an operation at the age of forty years.

Joseph Daniel Unwin was born on December 6, 1895, the son of Mr. F. D. Unwin of Chauntry House, Haverhill, Suffolk. He was educated at Shrewsbury School, and would have gone to Oriel College, Oxford, with a classical exhibition in 1914, had it not been for the outbreak of war. He served in the Northamptonshire Regiment and the Tank Corps, was twice wounded, and was awarded the Military Cross. After the War, he spent some years in Abyssinia. In 1928 he was elected a Fellow Commoner Research Student of Peterhouse, Cambridge. He then compiled a thesis in anthropology for the Ph.D., which was published in abbreviated form in 1933 under the title "Sexual Regulations and Cultural Behaviour". A fuller account of his research, with much additional material, was published as "Sex and Culture" in 1935. His theories of the relation of degrees or stages of culture and the intensity of sexual prohibitions, which was based upon evidence from no less than eighty tribes and peoples, attracted considerable attention and discussion. This book showed that Dr. Unwin had remarkable powers of analysing and marshalling cultural evidence. He had also engaged in research work for the Home Office on the subject of the imprisonment of debtors. The results of this research appeared in "Imprisonment for Debt" (1935). He also wrote "Notes on the Unwin Family" (1934).

Dr. Unwin's knowledge of social conditions and problems made his appointment as head of Cambridge House peculiarly suitable; and it was fully justified by his work for the settlement.

## Miss Alice Balfour

MISS ALICE BLANCHE BALFOUR, of Whittingehame, who died on June 12, at the age of eighty-six years, was a naturalist born and bred, and her scientific interest in Nature persisted in spite of the social

distractions of her association with her brother, Arthur James Balfour, politician and philosopher. In her earlier days, her bent was shared and encouraged by a younger brother, Prof. F. M. Balfour, already a leader in zoology when he died at the age of thirty-one years. Later she paid particular attention to gardening, so that the garden at Whittingehame became famous for its beauty, and to the collecting of a full series of the butterflies and moths of East Lothian. Her knowledge of the specific characters and local distribution of these and of other living things was thorough, and her inquiries brought her often to the Royal Scottish Museum in Edinburgh, to which she left her natural history collections.

It would be misinterpreting Miss Balfour's life to regard science as dominating her outlook, for her intellectual interests were wide, and her chief activities were social, in the broadest sense, and personal; but it may be said that the sustained pleasure of her life depended upon her love of Nature. J. R.

WE regret to announce the following deaths:

Prof. Franklin D. Barker, professor of zoology in Northwestern University, an authority on Trematodes, on July 10, aged fifty-eight years.

M. Louis Blériot, who made the first flight across the English Channel from Baraques, near Calais, to Dover, on July 25, 1909, in a monoplane having a three-cylinder engine of 22–25 horse-power, on August 1, aged sixty-four years.

Lieut.-General Sir Alfred Keogh, G.C.V.O., G.C.B., director-general of the Army Medical Service 1904–10 and 1914–18, and Rector of the Imperial College of Science and Technology, 1910–22, aged seventy-nine years.

Prof. E. J. Nanson, emeritus professor of mathematics in the University of Melbourne, on July 1, aged eighty-five years.

Dr. F. J. F. Shaw, director of the Imperial Institute of Agricultural Research, Government of India, aged fifty years.

# News and Views

### Dr. E. J. Allen, C.B.E., F.R.S.

ON July 30, a special meeting of the Council of the Marine Biological Association of the United Kingdom was held in the rooms of the Royal Society in order to appoint Dr. Stanley Kemp, former director of the "Discovery" expeditions to the antarctic, secretary of the Association and director of the Marine Biological Association at Plymouth, the appointment to take effect on October 1. The present director of the Station, Dr. E. J. Allen, retires at his own request on September 30 after forty-two years of arduous service to the Association. During this period, Dr. Allen has seen the Station grow from being a small and poorly equipped second-rate institution to becoming the premier marine biological station of the world. We propose to refer in a later issue to Dr. Allen's great services to zoological science.

### Dr. Stanley Kemp, F.R.S.

DR. STANLEY KEMP is probably the leading authority on oceanography at present living. During the years which he spent cruising in the Antarctic, he finally elucidated the circulation of the water in that ocean and proved its bearing on the habits and life-histories of the various species of whale which go south during the brief Antarctic summer in order to feed and grow fat and during this period fall a prey to whalers. He discovered the amazing fact that the largest of them all, the Southern Fin-Whale, feeds practically exclusively on one small species of 'shrimp' about 2 inches long. The baby whale when born is 20 feet long; it grows to a length of 50 feet during its first year, and attains its full size (100 feet long) in less than five years. He showed further that each antarctic summer is characterized by an enormous growth of diatoms on which these 'shrimps' feed and consequently a rich oxygenation of the sea-water due to photosynthesis. As this water flows north to the antarctic circle it sinks from the surface to an ultimate depth of about 600 fathoms and it takes approximately five years to reach the equator. The sequence of antarctic summers can be traced in the patches of oxygenated water which it contains, and the intensity of the oxygenation of each patch marks the degree of warmth of the corresponding summer. Dr. Kemp's appointment is therefore a happy augury for the future of Plymouth and for fishery science in general. It is becoming increasingly clear that the variations in British fisheries are connected with variations in intensity of a southward flow of arctic water carrying with it stupendous harvests of diatoms and shoals of the most sought-after edible fish. Oceanographic exploration based partly on Plymouth may be as fruitful in the endeavour to elucidate the life-histories of these fish as antarctic exploration has been in unravelling the life-history of the whale.

### Archæological Investigations in Syria

SIR LEONARD WOOLLEY's report on the work of the British Museum's archæological expedition to Sueidia, near Antioch, immediately before closing down work for the season (*The Times*, July 31) records the completion of excavation in the reserved area of the harbour site and the cutting of trial trenches on and around the hill station at Sabounia, two and a half miles inland. At the latter point, while the existence of a walled town at least as early as the Mycenæan age is established, the fall of the walls through the disintegration of the sandstone cliffs, on the edge of

which they were erected, has effectually disposed of the possibility of profitable excavation. Here, however, a find of vessels of copper and implements of bronze and iron has afforded instructive evidence of agricultural practice in Syria in the Byzantine age. At Sheikh Yusuf al Gharib further evidence was afforded of the activity of the port in the second half of the fourth century B.C., in the form of merchants' magazines, which had been burned, but had preserved a detailed picture of trade. A lamp store was stocked with lamps of both the imported and the locally made varieties, lamp fillers and Syrian oil bottles copying Greek models, while the stock of painted Attic *aryballi* bore witness to a common origin in common characteristics which made it possible to trace a definite shipment by a single firm and to date it within a few years. Gold and silver beads and silver coins of Athens, copper ingots and loose quicksilver marked a jeweller's shop. Back to the ninth century this is the most important Greek colony so far excavated. The absence of evidence from the earlier Mycenæan age is to be attributed to the forces of Nature, which have washed away the earlier portions of the site. Yet there is a link in a local copy of a Mycenæan vase and a single sherd of fine hand-made burnished black ware, which alone would suggest an earlier date. Though no inscription has been found, it is suggested that this is the ancient Posidium, mentioned by Herodotus as founded before the Mycenæan age.

### Bronze Age Burials in Scotland

A NUMBER of bronze age burials with some remarkable and unusual features, recently disclosed by building operations at Doonfoot, Ayr, and at Riccarton, Ferniegair, Lanarkshire, are described by Mr. Ludovic Mann in *The Scotsman* of July 20. At Doonfoot, no evidence of a cairn was discovered, but at Ferniegair, a structure of stone, of which the overground portion had been demolished, had covered a group of burials. Some eighty tons of loose stones, some water-rolled, formed an understructure in which horizontal layers of turf had filled the interstices and survived in the form of black carbonized matter. Both cemeteries have yielded pottery vessels of various types, assignable to successive phases of the bronze age and, therefore, pointing to an occupation covering a considerable period of time. The earliest form is a small squat hand-made food-vessel, with incised and impressed zonal ornament. Traces of carbonized cereal adhere to the interior. The bodies had been placed in the contracted position, looking toward the rising, or, in one instance, the setting sun, at Midsummer. Over one body at Ferniegair was sheeting made from the twisted and plaited stems of the Scottish moss, *Polytrichum commune*. Other examples of this textile material have been found at Mount Vernon, Glasgow, in a bronze age cairn near Stranraer, and a few weeks ago at Craignish, Argyll. Mr. Mann states that the dimensions of the stones of the tomb structures conform with an ancient linear measure, as do the interior dimensions of the chamber; and also that the position of the urn-fields, and other remains, ancient roads and tracks, conform, in a geometrical convention, also based on a common unit. Both at Doonfoot and Riccarton, adjoining burials contained large cinerary urns, with cremated remains, inverted over squared stone slabs. These overlie burials of the earlier inhumation period. At Doonfoot three burials were superimposed. A further find recorded is at Catacol, Lochranza, Arran, where a six-foot skeleton was found in the extended position in a long narrow chamber, constructed of small side slabs and heavy roofing stones. An iron object was found with the body.

### The National Central Library

THE twelfth annual report of the National Central Library refers to anxiety regarding the financial position of the Library due to inability to replace from any other source the £4,000 previously received as an annual grant from the Carnegie United Kingdom Trust. Fortunately, the Treasury grant-in-aid has been increased from £3,000 to £5,000 for a period of five years from April 1, 1936, and as a result the Carnegie Trustees have renewed their previous annual grant for a similar period. The continuance of both grants is conditional upon an increase in annual subscriptions from libraries by at least £2,000 by March 31, 1938. In consequence of the financial situation, expenditure on books has been only £2,338 but in addition to 3,110 volumes purchased, 5,451 volumes have been presented. The total number of volumes lent during the year was 118,288 and there are now 158 outlier libraries containing 6,303,000 volumes from which 10,002 volumes were borrowed. Reference is also made in the report to the extension of the regional system to cover the counties of Cornwall, Devon, Dorset, Gloucester, Hampshire, Oxford, Somerset and Wiltshire. When this system is established, the whole of England and Wales will be covered in eight regional systems, in addition to the London Borough libraries inter-lending system. Volumes lent to university libraries increased by 97 to 2,506. The system was used by 53 university libraries and 1,201 of the volumes were supplied by the National Central Library, 77 by foreign libraries and 1,228 by other university libraries, 80·52 per cent of the inquiries being supplied. The books supplied consist mainly of highly specialized and expensive books, books out of print, foreign books, back numbers of periodicals, or unpublished university theses.

### National Research Council of Canada

THE eighteenth annual report of the National Research Council, Dominion of Canada, covers the activities of the Council in 1934–35. During the year, the Associate Committees on Aeronautical Research and on Trail Smelter Smoke were re-organized and three important conferences were held, one on problems of the honey industry, another to formulate a programme of cold-storage investigations, and the third to investigate the potato situation and the utilization of a surplus. The work at the laboratory for laundry research conducted by the Council since 1930 has now led to the formation of a Canadian

Research Institute of Launderers and Cleaners. Reports from the various laboratory divisions summarizing work in progress refer to investigations on chemical weed killers, including a review of the literature, and on the biochemistry of rust resistance. The Division of Chemistry has devoted a considerable amount of attention to problems relating to carbon black, leather, paints and rubber. It has developed a method for plucking poultry which has received many favourable notices. A special wax has been prepared which can be used for removing the pen-feathers, and by its use poulterers can prepare birds for market which are cleanly plucked and attractive. Much work has been done on the conservation of Alberta's natural resources, while in the Fire Hazard Testing Laboratory of the Division of Physics and Engineering, the testing and listing of domestic oil burners has been studied and the drafting of safety codes has received attention. A joint Associate Committee with the Dominion Department of Agriculture has investigated field crop diseases while another such committee is concerned with grain research including the frost injury of wheat, methods of determining moisture in grain and the effect of carbon tetrachloride on the quality of damp wheat in storage. Other associate committees are concerned with the storage and transport of food, wood problems, wool, parasitology and engineering standards.

### *Organon*

THE first number of a new international review, *Organon*, has just been published in Warsaw by the Mianowski Institute. It is printed in French and English although all the authors are Polish, in order that a wide public may become familiar with the progress of scientific thought in Poland. The general character of the new publication can be gathered from the first group of contributions—"The Science of Science", "La Science, la religion et l'art", "The Man of Action and the Student", "Documents sur la psychologie de l'invention dans le domaine de la science", "Science and Scholarship in Poland to the Close of the Sixteenth Century", "Copernic", "Organisation de la science polonaise" and "Marja Sklodowska-Curie". The term 'science' is used in the widest possible sense, so that the new review will not be limited to contributions dealing only with the natural sciences. Two of the four historical articles have for their subjects the best known of Polish scientific workers, namely, Copernicus and Mme. Curie. It will be observed that the international character of science is well illustrated by the life and work of Mme. Curie. Polish by birth and French by marriage, her great discoveries were made with material from Bohemia which had been put at her disposal by Austrian authorities.

### The Science of Science

THE first contribution to *Organon* attempts to analyse the 'science' of scientific investigations. We are reminded that the problems of science can be grouped according to different principles. Thus, they may be classified as being connected with the philosophy of science, with its psychology or with its sociology. Such groupings and others in which further subdivisions are made do not avoid overlapping but, according to Drs. M. and S. Ossowski, they do serve to indicate that there can be a 'science of Science'. Against this view it can be urged that these problems already have their positions in well-defined fields (psychology, sociology, the theoretical parts of the separate sciences, etc.) but the Polish authors argue that the scope of this 'science of Science' comprises investigations concerning very widely separated subjects and brings them into internal harmony. The problems are attacked by many different means, but even here new links can be forged to bring the whole of science into one harmonious whole. The growth of science requires an extremely wide and many-sided supplementary apparatus, and the building of this apparatus requires theoretical studies.

### A Landmark of Horticulture

THE names of J. C. Loudon and his wife Jane Loudon will always be remembered gratefully by gardeners. Such exhaustive publications as the "Encyclopædia of Plants", the "Encyclopædia of Gardening", and the "Encyclopædia of Agriculture" led up to their culminating triumph, the "Arboretum et Fruticetum Britannicum". This was published in sixty-eight parts between January 1835 and July 1838, so that it is approximately one hundred years since this typographical monument was given to the public. Mr. W. Roberts, writing on "The Centenary of Loudon's 'Arboretum'" (*J. Roy. Hort. Soc.*, **61**, Part 7, July 1936), gives some interesting information about the methods by which the extraordinary amount of knowledge upon trees and shrubs was brought together. About three thousand questionnaires were circulated, in the days before the penny post, and Loudon received a very gratifying number of replies, the originals of which have been consulted by Mr. Roberts. Many of them bear striking testimony to the popularity of the Loudons, for invitations to stay at country seats were very numerous. An application to the Duke of Wellington resulted in his lordship mistaking the word Beeches for Breeches, and the signature for C. J. London. This he interpreted as from the Bishop of London, and accordingly dispatched the famous Waterloo breeches to that puzzled gentleman. The "Arboretum" and the other publications contain a great deal of information which is still of the greatest use at the present time. It is inevitable that the march of knowledge should add considerably to these solid foundations, but one feels that the £10,000 which the Loudons paid in amassing the knowledge and publishing the text of the "Arboretum" are still bearing handsome interest for the horticultural fraternity.

### Survey of India

THE General Report of the Survey of India for 1935 directs attention to the need for quicker revision of the maps of India. It was in 1905 that the Survey embarked on a scheme of 1 inch to 1 mile maps of

India, which was to be completed in twenty-five years and then revised every thirty years. Subsequent events led to a modification of the scheme. In 1913 it was realized that the allotted time was too short, and a smaller scale of map was sanctioned for the less populous areas. But the Great War and subsequent financial stringency still further curtailed the plan. By 1935 only two-thirds of the programme had been completed. Surveys are being carried out at the rate of about thirty-nine thousand square miles a year, and if this can be maintained the programme will be completed in about sixteen years. Meantime, the maps of a large part of India, except on a small scale, are much out of date and printed mostly in black only. The Report contains a key map showing the degree of obsolescence of various sheets. Maps of India, Burma and adjacent countries on the 'one million' scale are now practically complete and the sheets of the Carte Internationale are approaching completion. A separate publication of the Survey of India is an Index to Annual Reports, 1904–5 to 1926–27.

### Discoveries in Antarctica

SOME valuable details of new discoveries in Antarctica accompanied by photographs are contained in an article in the *National Geographic Magazine* for July by Mr. L. Ellsworth on "My Flight across Antarctica". It will be remembered that in December of last year, Mr. Ellsworth reached the Bay of Whales in the Ross Sea after a flight from Dundee Island, Graham Land. This took him over an entirely unknown part of Antarctica to the Pacific side of the Pole. South of Stefansson Strait he discovered a lofty rugged mountain range with an apparent trend between north-north-west and south-south-east. Farther on, other peaks appeared, one rising to 13,000 feet. Mr. Ellsworth made several landings in about lat. 80° S. and found a plateau at an elevation of more than 6,000 ft. He gave the names Hollick-Kenyon plateau to this elevated country, and James W. Ellsworth Land to the whole area between Hearst Land and Marie Byrd Land. The photographs of the new mountains do not suggest the block faulted mountains of Queen Maud Ranges, but rather the Andean ranges of Graham Land which, from Admiral Byrd's recent discoveries, would seem to continue into Edward Land.

FURTHER light on this problem is shed by an article by Mr. W. L. G. Joerg in the *Geographical Review* of July on "The Topographical results of Ellsworth's Trans-antarctic Flight". Mr. Joerg has mapped the direction of the new ranges as far as available data allow, and his map appears to confirm the suggestion of R. Staub that the axes of the Antarctic Andes of Graham Land spread fanwise in Hearst Land. Each of the newly discovered ranges seems to be a continuation of one of the three-fold lines of Graham Land. The relation of these folds to the plateau land of Antarctica has still to be determined, and Mr. Joerg's suggested direction does not continue into Edward Land. Mr. Ellsworth's photographs also suggest that Stefansson Strait is narrower than previously supposed, or possibly that it is an embayment on the east of Graham Land and not a strait. Its eastern entrance lies mainly north of the seventieth parallel. The discoveries open a field for future ground exploration.

### Recommended Values of Illumination

THE Illuminating Engineering Society has issued a list of the values of illuminations which are recommended for various purposes. It has been prepared by the Technical Committee of the Society, and copies of the full recommendations can be obtained from the Honorary Secretary, I.E.S., 32 Victoria Street, S.W.1, price 6*d*. Since the candle-powers of electric lamps are known and the distance of the lamps from the work bench can easily be estimated, it is not difficult to estimate the candle-power. The committee recommends that if the task requires both discrimination and response, the foot-candle value should be at least 50. For severe and visual tasks such as fine engraving, sewing of dark goods, and discrimination of fine details of low contrast, the foot-candle value should not be less than 25. For prolonged critical visual tasks such as proof-reading, type-setting, drawing, reading, fine machine-work, fine assembling and use in large stores, a foot-candle value between 15 and 25 is recommended. A foot-candle value of 8–15 would be suitable for visual tasks such as detailed office work, skilled bench work and sewing on light goods and for retail shops. For less-exacting visual tasks, such as general office, large assembly work and classrooms, 5–10 suffices. For work of a simple character not involving close attention of fine details, 3–5 foot-candles is suitable. For casual observation where no specific work is performed, 2–4 foot-candles is regarded as sufficient.

### Streamlined Trains

PEOPLE who have travelled in the new lightweight high-speed trains may have wondered why this new development has not come into wider use, and look forward to the time when most passenger trains will be similarly streamlined. According to a report issued by Science Service of Washington, D.C., L. K. Sillcox, the engineer of the New York Brake Company, discusses this point in a report to the American Society of Mechanical Engineers. He says that only about 20,000 route miles of the main lines of the railroads of the United States are fitted by their curves, grades and traffic to be usable for lightweight trains that can go at 100 miles an hour. This length of railway is only about ten per cent of the total mileage of railroads in the United States. It is well known that crowds will gather to see a passenger locomotive go by if it is fitted with a metal shroud that helps its streamlining or presents what the public thinks is a streamlined appearance. But this shroud adds 13,000 lb. to the weight of the locomotive. Another drawback is that the equipment has to be built very robust. Like motor-cars, the internal equipment has to be turned over and renewed every few years. In addition, any new railroad rolling stock

has to be designed so that it is in keeping with the older equipment. A large reserve of the old equipment has to be maintained to meet the changing traffic demands made on it. Some engineers are afraid that there may be a public reaction after the very pleasant boon which the railways afforded when streamlined trains were first used. There is evidence of dissatisfaction when the public learns that a 100–120 miles an hour train is placed in revenue service on a 50–60 miles an hour schedule. Even although the maximum speed has been attained *en route*, the public feels that it has been misled.

### Agricultural Research Institutes in Great Britain

THE Ministry of Agriculture has now published the report of the work of the agricultural research institutes in the United Kingdom for 1933–34 (London: H.M. Stationery Office; 5*s*. net). Besides describing the investigations carried out at the forty-four principal institutes, the report deals with the work at various advisory centres and special State-aided researches carried out in different parts of the country. The problems concerned cover a wide field, including soils, plant nutrition, physiology, breeding and disease, dairying, animal nutrition, breeding, diseases and pests, food preservation and transport, and agricultural engineering. Should anyone desire further information, a list of papers published from each centre is supplied so that reference to the original source of the work is available, and inquiries may also be addressed to the director of the institute or person concerned, the names and addresses of whom are listed.

### The American Amaryllis Year Book

THE American Amaryllis Society has issued vol. 2, its Year Book for 1935 (from the Editor, Dr. Hamilton P. Traub, Mira Flores, Orlando, Florida, U.S.A.). It is dedicated to Theodore L. Mead, in recognition of his pioneer work with hybrid *Hippeastrum* plants. Gardeners are familiar with narcissi, they bestow a rather occasional interest upon day lilies (*Hemerocallis* spp.), they cultivate *Alstrœmeria*; but most horticulturalists have not yet realized the wonderful beauty displayed by the new hybrids of *Hippeastrum*. The Society has an international outlook, for a large part of the volume is devoted to regional activities in Australia, Kenya, Europe, and all parts of America. A section on "Description and Phylogeny" quotes *inter alia* from Dr. J. Hutchinson's recently published volume on the classification of monocotyledons. Robert F. Ruthruff contributes a paper describing the alkaloids found in various Amaryllidaceæ, and the late Dr. David Griffiths directs attention to "Opportunities for Breeding with Daffodils". Two valuable papers by Miss Ida Luyten and Dr. Traub introduce new methods of vegetative propagation of amaryllids. Fifteen papers deal with culture, five with curing, storage and forcing, and a similar number with marketing. The editor has introduced the idea of quoting one or two abstracts from scientific papers relevant to *Amaryllis* culture, and though the index shows nearly sixty papers, no subject appears to have inadequate treatment. Plans have already been made for publishing year books so far ahead as 1938; the Society occupies a position of great utility and high æsthetic value.

### Early Photographs

THE June issue of the *Alumnus Chronicle* of the University of St. Andrews contains an article by Mr. J. H. Read describing a collection of prints by early photographers which illustrate the local development of the art and have been presented to the University by Mr. James Thomson of Inverness. The oldest photographs of the collection are of buildings in St. Andrews produced by the Calotype process about the year 1840. Portraits of St. Andrews worthies, for example, Sir Lyon Playfair and Sir David Brewster, by the process date from about 1850. The majority of the photographs are albumen prints from wet collodium plates taken during the next twenty years, and include portraits, scenery and reproductions of pictures. The article is illustrated by reproductions from paper negatives by Thomas Rodger of a St. Andrews fishing quarter in 1843, and a portrait of Prof. George Day, professor of medicine, 1850, both of which are remarkably good.

### Films and their Utilization

THE current number of *Film Progress* is in two parts. It contains the usual supplementary bulletin to the National Encyclopædia of Films. In this section are noted a good number of films, both 35 mm. and 16 mm., of G. B. Equipments and Pathé. Silent films of Ensign and C.I.B.E.F. are also listed. The other section deals mainly with the educational value of the sound film. This is in effect a résumé of the arguments put forward by C. F. Hoban in a symposium on "Sound and Silent Films" held at the University of Chicago. The arguments are well stated, but the article reads too much like special pleading, seeing that the arguments for the silent film presented to the symposium are not mentioned. We hope that they will be stated in a future number.

### Third World Power Conference

THE following official delegates have been appointed to represent the Government of the United Kingdom at the Third World Power Conference and Second Congress, International Commission on Large Dams of the World Power Conference, to be held concurrently in Washington, D.C., on September 7–12: Viscount Falmouth, Mr. N. G. Gedye, Mr. T. Hardie, Mr. J. M. Kennedy, Dr. F. M. Lea, Mr. Charles H. Merz, Sir Archibald Page, Mr. C. Rodgers, Dr. F. S. Sinnatt and Mr. E. T. Williams. The final time-table for the Conference has now been announced. The joint opening session will be held in Constitution Hall, Washington, on Monday, September 7, at 8.30 p.m. Business sessions will be held earlier on the same day and throughout the week. There will be an address by the President of the United States on September 11 at 2 p.m. followed by a garden party and reception at the White House.

### Building Exhibition at Olympia, London

THREE HUNDRED AND FIFTY firms and associations have already booked space in the twentieth biennial Building Exhibition which is to be held at Olympia, London, on September 16–30. This number of exhibitors is in excess of the number which exhibited on the last occasion in 1934, and an increase of about 10 per cent in the total number may be expected. The Department of Scientific and Industrial Research is again to have a large exhibit, and this will cover not only the work of the Building Research Station, but also that of the Forest Products Research Laboratory, Princes Risborough, and the National Physical Laboratory, Teddington. The Building Research Station exhibit will deal with plastering materials; common types of failure caused by using unsuitable material or by faulty construction; concretes, with special emphasis on light-weight concrete; further work on the driving of concrete piles; the measurement of strain on masonry structures; and the weathering of building stone. The work of the Forest Products Research Laboratory illustrated in the Exhibition will deal with the correct moisture content of timbers for various purposes; wood-working, with special reference to new and difficult timbers; and wood preservation and protection against the death-watch and other beetles. The National Physical Laboratory's exhibit will deal chiefly with building acoustical problems, models being shown of typical quiet and noisy rooms. Short-length films are to be shown by the Department on its stands.

### Observations on Comets

A CONSIDERABLE number of observations of Peltier's comet are now available, and the Rev. Dr. M. Davidson has computed a new orbit, using observations from May 16 to July 15, the latter being made by Dr. W. H. Steavenson and independently by Mr. Will Hay. The period appears to be about 1500 years, but observations from the southern hemisphere, in which the comet can be followed up to October, will enable computers to obtain a more accurate period. The comet is rapidly moving south, and will not be visible in these latitudes after August 6. A comet of sixth magnitude was discovered by Kaho on July 17, and a number of observations have since been made at various observatories and also by members of the British Astronomical Association. The orbit given below was computed by Whipple and Cunningham, but as the observations used were very rough, the orbit is only approximate. Dr. Crommelin, having received more accurate observations, is now engaged in computing a general orbit. The comet is receding from the earth and sun and is fading rapidly.

Orbit of Comet 1936a (Peltier)
Computed by Rev. Dr. M. Davidson

| | | |
|---|---|---|
| T | 1936 July 8·95141 U.T. | |
| $\omega$ | 148° 28′ 32·0″ | 1936·0 |
| $\Omega$ | 134 02 18·8 | 1936·0 |
| $i$ | 78 32 51·6 | 1936·0 |
| $a$ | 130·681 | |
| $e$ | 0·991584 | |
| $q$ | 1·099748 | |

The period is nearly 1,500 years.

Orbit of Comet Kaho
Computed by Messrs. Whipple and Cunningham

| | | |
|---|---|---|
| T | 1936 July 13·700 U.T. | |
| $\omega$ | 40° 56′ | 1936·0 |
| $\Omega$ | 262 02 | 1936·0 |
| $i$ | 123 08 | 1936·0 |
| $q$ | 0·5220 | |

### Announcements

ROBERT ESNAULT-PELTERIE has been elected a member of the Division of the Applications of Science to Industry of the Paris Academy of Sciences in succession to the late Jean Rey.

AT the quarterly meeting of the Royal College of Physicians held on July 30, the Weber-Parkes Medal and Prize were awarded to Sir St. Clair Thomson for his work on tuberculosis of the larynx, and the Moxon Gold Medal to Prof. Edward Mellanby for his work on the problems of nutrition. The Harveian Oration will be delivered by Sir Walter Langdon-Brown on October 19, at 4 p.m. Dr. Arthur Hurst has been appointed Harveian Orator for 1937 and Dr. E. A. Cockayne Bradshaw Lecturer for 1937.

THE Royal Academy of Belgium has made the following awards: Lefebvre Prize to MM. Wattiez and Sternon; Laurent Prize to M. R. Bouillenne; Van Beneden Prize to M. J. Brachet and grants from the De Potter Fund to M. A. Gardedieu, M. Capron, M. van den Bruel and M. Florkin.

DR. GOTTLIEB HABERLANDT, emeritus professor of botany in the University of Berlin, has been made an honorary member of the Academy of Sciences of Vienna.

THE Austrian Society for Roentgenology will hold its annual meeting at Vienna on September 4–8. Further information can be obtained from Allgemeines Krankenhaus, Zentral-Roentgen Institut, Alserstrasse 4, Wien 1.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Junior assistants (physics or chemistry) in the Chemical Defence Research Department (War Department)—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (August 12).

A lecturer in electrical engineering in Walsall Technical College—The Director of Education, Education Offices, Council House, Walsall (August 15).

An assistant lecturer and demonstrator in civil engineering in University College, Cardiff—The Registrar (August 19).

A part-time assistant lecturer in the Department of Physics and Applied Physics in the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (August 24).

An assistant director of the Plant Pathological Laboratory, Harpenden—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (August 31).

A senior assistant in the Department of Surgery of the Royal Veterinary College—The Secretary (August 31).

An assistant curator in the Royal Albert Memorial Museum, Exeter—The Town Clerk, Exeter (August 31).

A lecturer in physiology in the University of Western Ontario, London, Ontario, Canada—The Dean of the Medical School.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 250.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Energy of Formation of 'Cyclol' Molecules

ACCORDING to the cyclol theory of the structure of proteins[1]—a *working hypothesis* recently put forward in these columns—the polypeptide, the essential unit in the molecule on the classical theory, is

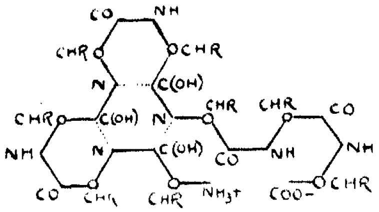


FIG. 1.

replaced by the cyclized polypeptide (Fig. 1): correspondingly the classical peptide links (joining one pair of C,N atoms) are replaced either by the double peptide links (joining two pairs of C,N atoms) or by the triple peptide link (joining three pairs of C,N atoms) (Fig. 2). The reaction

polypeptides ⇌ proteins

is thus regarded as a ring chain tautomerism[2], which takes the form

$$\rangle\!\!\!\!\!\!/\mathrm{N}\quad(\mathrm{HO})\,\mathrm{C}\!\!\!\langle\!\!\!\langle \rightleftharpoons \rangle\mathrm{N}-(\mathrm{HO})\,\mathrm{C}\langle \qquad (1)$$

if the appropriate groups are in the imide form, and the form

$$\rangle\mathrm{NH}\quad \mathrm{O}=\mathrm{C}\langle \rightleftharpoons \rangle\mathrm{N}-(\mathrm{HO})\,\mathrm{C}\langle \qquad (2)$$

if they are in the amide form.

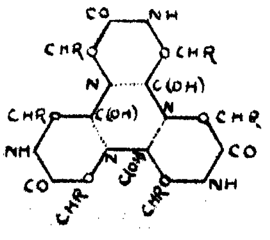


FIG. 3.

The precise data required for an estimate of the energy balance in the process of formation of cyclol molecules from polypeptides are not yet available, but we may consider cyclol 6 (Fig. 3) as an indication of the situation, in the hope of directing attention to the fact that certain data are urgently required.

The figures[3] for heats of formation of various links, in kilogram calories, are as follows:

| | | | | | |
|---|---|---|---|---|---|
| C−O | 82·8 | (alcoholic ethers) | C=N | 119·6 | ('estimated') |
| C=O | 177·8 | (ketones) | O−H | 109·5 | ($H_2O$) |
| C−N | 61·5 | (amines) | N−H | 83·3 | ($NH_3$) |

With these figures, the energy changes are as follows:

One amide to imide transformation,

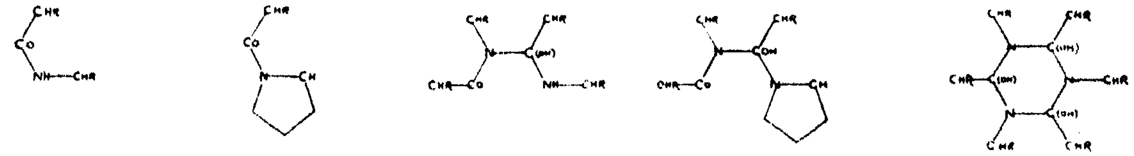
$$(177{\cdot}8+61{\cdot}5+83{\cdot}3)-(82{\cdot}8+109{\cdot}5+119{\cdot}6)=+10{\cdot}7.$$

One transformation of type (1),

$$(119{\cdot}6)-2(61{\cdot}5)=-3{\cdot}4.$$

One transformation of type (2),

$$(177{\cdot}8+83{\cdot}3)-(82{\cdot}8+109{\cdot}5+61{\cdot}5)=+7{\cdot}3.$$



Single peptide links. Double peptide links. Triple peptide link.

FIG. 2.

According to these figures, the formation of cyclol 6 from a closed polypeptide consisting of 6 residues requires 21·9 kilogram calories if the polypeptides are in amide form throughout; if the three links concerned are already in the imide form, energy amounting to 10·2 kilogram calories is emitted. In these calculations, no allowance is made for resonance, which amounts to 20 kilogram calories for acetamide.

The calculation for the process of linkage (1) suggests that if the synthesis of proteins is a process of cyclization of polypeptides (or indeed if it is a process of polymerization of substituted diketopiperazine molecules), it is facilitated if the appropriate groups are in the imide form. The implication is that certain enzymes operate directly on the substrate by imposing on some of its (CO,NH) groups, the imide form −C(OH)=N−. This deduction from the cyclol hypothesis gains support from the researches of Bergmann and his co-workers on dipeptidase, which led them to assume[4] that the "hydrogen atom becomes rearranged under the influence of the enzyme in such a way that the amide form of the dipeptide is changed to the imide form −CO−NH− → −C(OH)=N−".

The implications of the calculation for the process of linkage (2) are explored in the accompanying letter by my colleague, F. C. Frank.

D. M. WRINCH.

Mathematical Institute,
Oxford.

[1] D. M. Wrinch, NATURE, **137**, 411 (1936).
[2] See, for example, J. W. Baker, "Tautomerism" (1934), p. 38.
[3] The figures of Pauling and Sherman given in *J. Chem. Phys.*, **1**, 606 (1933), calculated on the basis of the value of 208 kilogram calories for the heat of dissociation of $N_2$, have been modified to take account of the revised value of 160 kilogram calories (see Mulliken, *Phys. Rev.*, **46**, 144 (1934); Herzberg and Sponer, *Z. phys. Chem.*, B, **26**, 1, though this modification is without effect on these calculations.
[4] *J. Biol. Chem.*, **109**, 325, 329 (1935).

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WRINCH[1] recently proposed that in monolayers or globular molecules of proteins, polypeptide chains are knitted into a fabric by the bonding process

$$>C=O + HN< \rightleftarrows >C(OH)-N<,$$

which Frank[2] had shown to be required in keratin to make permissible the structure Astbury deduced for it by X-ray crystallography. It is desirable to estimate the energy balance of this process, which is chemically analogous to lactam-lactim tautomerism, or to the ring closure in sugars associated with mutarotation.

Taking link values of heat of rupture from Pauling and Sherman[3], we find the process of linkage represented above is endothermic by about 7·3 kcal., while a lactam-lactim transformation is 10·7 kcal. endothermic, without allowance for resonance energies in either case. Resonance in the lactam form increases both these figures by some 20 kcal., if taken as the same as in acetamide: there must be a similar but presumably smaller resonance energy in the lactim, but the 'cyclol' molecule in itself offers no chance of constructing a resonant system.

Though these are not free energies, and in any event not very accurate, they appear certainly too large to allow the equilibrium to rest close to the right hand of the equation, as the theory requires, so that we must either abandon the theory or find some compensating source of energy. This is provided in the keratins by strain in the side-chain cross-linkages, which Astbury[2] and Speakman[4] have shown to provide the main driving force of contraction from the β-form. In the proposed 'cyclol' monolayers, we have a similar source of energy which we may call a heat of crystallization, for the cyclization into a compact strainless form is evidently at the same time a process of two-dimensional crystallization; but this by itself cannot be sufficient.

An additional source is provided by hydration (or association through hydroxyl bonds generally), which is well known to stabilize lactims, non-chelate enols, and hydroxylic tautomeric forms in general[5], a fact directly related to their superior solubility in water and other hydroxylic solvents. Not only the hydroxyls but also the nitrogens, which are more aliphatic in nature in the cyclized form, are available for hydration: protein hydroxyls can also associate with each other. Each hydroxyl bond formed may be supposed to provide energy of the order of half the internal latent heat of vaporization of ice, thus about 5 kcal., so that the whole may be a sufficient compensating source of energy, about 20 kcal.

Thus it appears that if the protein molecules are fabricated with the aid of this linkage, they can only be stable when hydrated. Any conditions tending to dehydration will render the protein excessively liable to opening into chain forms, unless restrained by side chains or deprived of catalysts necessary for transformation. Mildly dehydrating conditions should be most effective because water is a catalyst for transformation as well as a stabilizer of one form. So long as the rings only occasionally open they can re-form in the same configuration, but as soon as the opening becomes too frequent this will cease to be the case and they will then re-form in altered structures, derived more directly from open chains. This conforms with all observations on the processes of degeneration and denaturation, including Astbury's X-ray studies of these processes[6,7]. Thus what seems at first to be a destructive obstacle to the theory may be capable not only of reconciliation with it, but even of enhancing its effectiveness.

F. C. FRANK.

Engineering Laboratory,
Oxford.
July 7.

[1] D. M. Wrinch, NATURE, **137**, 411 (1936).
[2] See W. T. Astbury, *Proc. Textile Inst.* (1936), in the press.
[3] L. Pauling and J. Sherman, *J. Chem. Phys.*, **1**, 606 (1933).
[4] J. B. Speakman, *Proc. Textile Inst.* (1936), in the press.
[5] See, for example, J. W. Baker, "Tautomerism" (1934), p. 38.
[6] W. T. Astbury and R. Lomax, *J. Chem. Soc.*, 846 (1935).
[7] W. T. Astbury, S. Dickinson and K. Bailey, *Biochem. J.*, **29**, 3351 (1935).

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## Insect Coloration

IN the article on the Oxford Congress of the South Eastern Union of Scientific Societies in NATURE of July 11, p. 88, reference is made to the address of the president, of which the main topic was the coloration of insects by natural selection. Prof. Hale Carpenter is reported as saying:

"Sometimes it pays an insect to change its appearance according to whether it appears in a dry or in a wet season. Poulton pointed out that a dry season is one of scarcity of food, and certain butterflies then remain inconspicuous and of skulking habits, whereas in a wet season they are conspicuously coloured, and they can afford to allow some of the species to be eaten by reason of their number."

Prof. Hale Carpenter referred to an African *Charaxes*, which is conspicuous in the wet season but in the dry assumes a dead-leaf-brown and deliberately hides itself among clusters of dead leaves. To assert that an insect *deliberately* hides, is going far. When bug hunting in Australia and Sumatra, it seemed to me that the butterflies all made for shade behind leaves, when not madly careering in the sun. May not the food in the two seasons vary, not merely in quantity but in quality? It certainly will. The temperature also. As we know nothing about the relation of coloration to quality of food, the subject is beyond discussion, at present. Darwinian discussion is largely on 'Alice' lines. No chemist can believe in change by any process of direct mimicry—nor even a MacBride. Nature is held under strict enzymic control, though inspection of any good collection shows the actual variations are very wide. Discussions too are often wide of the mark: if they were all scientific, our shelves would have an easy burden. Are the morals of the insect world on so high a plane that it can be asserted that there has never been a cross of mimetics? Mistakes, we know, are made even in the best regulated families.

HENRY E. ARMSTRONG.

55 Granville Park,
Lewisham, S.E.13.

PROF. ARMSTRONG'S criticisms are easily met. It is *not* going too far to "assert that an insect *deliberately* hides". The taking temporary shelter from sun is a different matter from assuming a position of complete rest in surroundings best suited to concealment for long periods. The case I mentioned was undoubtedly deliberate choice of a cluster of dead leaves, among others, by a *Charaxes*. I have repeatedly watched the Pierine butterfly *Eronia cleodora*, having been disturbed from undergrowth where it had settled late in the evening, deliberately settle again, after previously fluttering around, among the half-dead leaves from which it had been disturbed and with which its patchy yellow underside closely matched. The late Dr. G. B. Longstaff recounts the same experience on p. 194 of his book, "Butterfly Hunting in Many Lands", and gives a very accurate coloured plate to illustrate the point. Has Prof. Armstrong never studied photographs of procryptic geometrid moths on the bark of trees, which do not rest in haphazard positions but take up an attitude bringing the edges of their front wings into line with the edge of a crack in the bark, and putting the main features of their pattern into harmony with the surface on which they rest?

Prof. Armstrong says that "No chemist can believe in change by any process of direct mimicry". It is a little difficult to understand precisely what is meant. Is he aware of the facts concerning *Papilio dardanus*? In this butterfly the light yellow pigment of the male, and the ancestral form of female like it, fluoresces in ultra-violet light, but in the mimetic forms of female the fluorescence has been lost: this surely implies a chemical change.

The last point raised by Prof. Armstrong is a form of the old and out-of-date argument that mimicry is merely an expression of affinity.

No one, I think, would venture to assert that the close mimetic likeness of a moth to a Hymenopterous insect such as an ichneumon-fly is due to hybridization! Would Prof. Armstrong account for the likeness of a moth or a beetle to a bird-dropping in the same way? Such a resemblance is of the same class as mimicry, and an explanation other than natural selection which accounts for both has yet to be found.

G. D. HALE CARPENTER.

University Museum,
Oxford.

## Palæozoic Seismicity

EVIDENCE of contemporaneous disturbances during the deposition of Ordovician strata has recently been collected at localities in the Irish Free State including Portraine, Balbriggan, Raheen Bridge and Tramore. This comprises breaking up and slumping of limestone beds, rapid alternations of shale and graded sand (greywacke sedimentation), breccia beds between sub-parallel undisturbed layers, and anti-dune wave-crests in mud. The cause probably lies in seismicity associated with the instability of the Lower Palæozoic geosyncline.

It now seems possible to demonstrate that the 'crush-conglomerates' and 'thrust-conglomerate' distinguished by Reynolds and Gardiner[1] at Portraine are paene-contemporaneous effects, since the Portraine limestone contains unbroken layers intercalated between beds brecciated *in situ*, and 'landslip' masses (Fig. 1). North-west of Balbriggan, one has a repetition of several of the features which Henderson[2] at Girvan ascribed to seaquakes and tidal waves. In County Waterford, greywacke beds with breccias have been examined on the coast north of Raheen Bridge. The shaly fragments in these remain so sharply angular that they must have become embedded in their present sandy matrix almost as soon as they were disrupted. The possibility of tsunamis, after earthquakes, carrying shore sand out to sea among disturbed shaly sediments, as suggested by Bailey and Weir[3], must be carefully considered. In the Carrigaghalia Series of Reed[4], on the north side of Doneraile Cove, Tramore, wave-crests of mud, in the anti-dune phase, have been discovered preserved in tuffaceous sand. The only explanation in this case seems to be that the sandy detritus was deposited by a tsunami, the swift passage of which induced the anti-dunes. Examination of one wave-crest about ¾ inch high, indicates that it is in no way a compressional structure due to pressure by an overlying column of sand differentially weighted, but shows loosening out of the muddy laminæ.

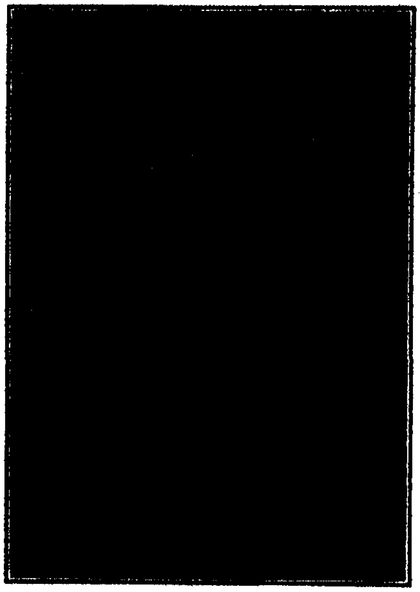

FIG. 1. Slumping of limestone beds in shale. Height of section, about 8 feet. Priest's Chamber, Portraine, Co. Dublin.

This work casts grave doubt on the views of Kilroe and McHenry[5] regarding 'intrusive tuffs' in south-eastern Ireland. These anomalous clastic beds probably originated as water-laden sand which, under seismic conditions, might behave with the mobility of an igneous rock.

The Irish disturbances I have noted are of Caradocian age—the Portraine beds may be correlated with the Robeston Wathen limestone in Wales—and this epoch may be regarded as one of marked seismicity.

There is no doubt that seismic activity must have prevailed at many stages during the development of the Lower Palæozoic geosyncline. Certain breccias in Arenig greywackes of the west of Ireland are unquestionably attributable to it. One example figured by Gardiner and Reynolds[6] from Glensaul may be taken as typical. It occurs sharply bounded between undisturbed layers, the narrowness and unbroken nature of which exclude the contingency of

frictional brecciation. A similar interpretation seems to apply to the 'crush-conglomerates' described by Lamplugh[7] from the Manx Slate Series. In the Lower Cambrian (?) of Howth, near Dublin, greywackes and shaly breccia—'sherd-schist'—appear to me to provide at a still earlier period an indication of contemporaneous disturbances.

As an example from another geosyncline, there are the graded sediments of the Middle Devonian of New South Wales. From these, Benson[8] figures an example in which a claystone layer has two anti-dune wave-crests picked out in tuffaceous sand. He describes the latter as 'intrusive'. But it is more likely to have been carried into place by a tunami. The specimen, I believe, has been figured upside down.

It may be added that a recurrence of seismic conditions in carboniferous times in the Dublin district seems to be indicated by anti-dune wave-crests in mud which have been found in beds of Yoredale age at Loughshinny. These beds show rapid alternations of shale and graded sand. Their evidence is corroborated by brecciation *pari passu* with deposition in $D_2$ limestone at Curkeen Hill quarry.

ARCHIE LAMONT.

Department of Geology,
University,
Glasgow.
June 25.

[1] "Crush-Conglomerates in Ireland", NATURE, **53**, 488 (1896); "An Account of the Portraine Inlier (Co. Dublin)", *Quart. J. Geol. Soc.*, **53**, 527–534 (1897).

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## Density and Compressibility of Solid Hydrogen and Deuterium at 4·2° K.

IT has been shown by Bennewitz and Simon[1] that the influence of zero-point energy on the properties of a condensed substance is very great for substances of low boiling point. The effect is most marked in helium[2], where it actually plays the chief part in determining the properties; but it is large, too, in hydrogen, a substance which is particularly interesting as it possesses two isotopes which have identical binding forces but very different zero-point energies.

Certain of the properties of the solid phases have been measured already, by Simon and Lange for hydrogen[3] and by Clusius and Bartholomé for deuterium[4], among them being the specific heats at constant pressure, the heats of evaporation and melting, and the molar volumes at the triple points. Clusius and Bartholomé have discussed in their very interesting paper the influence of zero-point energy by comparing the properties of the two isotopes. Nothing was hitherto known, however, of the compressibilities. These are of special interest because the zero-point energy gives rise to a pressure $p^{(\circ)}$, and its variation with volume to a compressibility[2] $K^{(\circ)}$, which, as a preliminary estimate shows, will be an important part of the total compressibility. At the same time, a knowledge of the molar volumes at the boiling point of helium will give us very nearly their values at absolute zero, and, using the known values at the triple points, the mean thermal expansions.

For obvious reasons, we had to use a pyknometer method. The only substance available as a filling liquid is liquid helium, and since its compressibility is very much greater than that of solid hydrogen, the method cannot be one of high accuracy. But as hitherto even the order of magnitude was not known, we thought it worth while to carry out the experiment.

A vessel of known volume (about 4 c.c.) was attached to a helium liquefier of the expansion type; it was nearly filled with condensed hydrogen (or deuterium), and when this was solid, completely filled with liquid helium at a pressure of about 100 kgm./cm.$^2$. By letting out successive amounts of helium and measuring them as a gas at room temperature, and afterwards measuring in the same way the hydrogen, the density of the solid hydrogen at each pressure could be calculated. The results are given in the accompanying table.

| | Hydrogen | Deuterium |
|---|---|---|
| Density (gm./cm.$^3$) at 1 kgm./cm.$^2$ and 4·2° | 0·0890 ± 0·0004 | 0·2059 ± 0·0010 |
| Molar volume (cm.$^3$) at 4·2° | 22·65 ± 0·1 | 19·56 ± 0·1 |
| Compressibility (cm.$^2$/kgm.) at 4·2° (average from 1 to 100 kgm./cm.$^2$) | (5·0 ± 0·5) × $10^{-4}$ | (3·3 ± 0·7) × $10^{-4}$ |

As to the compressibilities, it may be remarked that the curve of volume against pressure is, as expected, not a straight line. In the above table, however, only the mean compressibility between 1 and 100 kgm./cm.$^2$ is given, since it is known more accurately than the compressibility at any given pressure. But it may be noted that the compressibility at 100 kgm./cm.$^2$ is for both isotopes roughly half that at 1 kgm./cm.$^2$. For the thermal expansion, assuming for a rough estimate that it is proportional to $C_p$, and combining the molar volumes at 4·2° with those at the triple points, we find that at a given temperature the expansion coefficient of deuterium is about half that of hydrogen.

We intend to publish a more detailed account of these experiments, and will postpone until then the theoretical discussion of our results, which we hope to consider also from the point of view of F. London's treatment of helium[2]. Here we should like to point out only that, for hydrogen, $p^{(\circ)}$ amounts to about 1,000–2,000 atm., and $K^{(\circ)}$ accounts for a very great part of the total compressibility.

Our sincere thanks are due to Dr. N. Kürti for his constant help in carrying out the experiments.

H. D. MEGAW.
F. SIMON.

Clarendon Laboratory,
Oxford.
July 10.

[1] *Z. Phys.*, **16**, 183 (1923).

[2] F. Simon, NATURE, **133**, 529 (1934); F. London, *Proc. Roy. Soc.*, A., **153**, 576 (1936).

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## Quantum Relationship of the Light-emitting Process of Luminous Bacteria*

WE have studied the relation between the oxygen consumption and the light intensity of a suspension of luminous bacteria (*Photobacterium phosphoreum*) by measuring simultaneously, at different concentrations of potassium cyanide, the oxygen consumption by the ordinary Warburg method and the light intensity with the aid of a photometric method.

It could be shown that the oxygen consumption consisted of two main parts: one of which was inhibited completely by about 0·001 mol. potassium cyanide, whereas the other decreased slowly with increasing concentration of the cyanide and in proportion to the light intensity.

In plotting the light intensity against oxygen consumption, the lower part of this curve was a straight line, giving the percentage of oxygen consumed in the light-emitting process. This proved to be 19 per cent of the total amount of oxygen consumed.

As the light emission could be measured in absolute units, the number of molecules of oxygen consumed per quantum of light emitted could be computed. At 16° C. the mean value obtained was 500 molecules of oxygen per quantum.

It seems remarkable that, whereas the percentage of oxygen consumed in the light-emitting process proved to be constant under different conditions and at different temperatures, the light intensity varies a great deal. It must be concluded, therefore, that the efficiency of the light-emitting process is dependent on various, as yet unknown, factors.

K. L. VAN SCHOUWENBURG.
JOHANNA G. EYMERS.

Physical Institute,
University of Utrecht.
July 16.

* Preliminary communication from the Rockefeller Biophysical Research Group under the direction of Prof. L. S. Ornstein (Utrecht) and Prof. A. J. Kluyver (Delft).

## The Lower Regions of the Ionosphere

IN our recent letter to NATURE[1], we did not mean to infer that reflections from the 60 km. level had not been found before. So early as 1930, Appleton[2] noticed reflections of this type. In 1935, Mitra and Syam[3] recorded reflections from this level using the pulse method of Breit and Tuve. The only addition we made to existing knowledge was that this high level forms the top of a region extending from 40 km. to 55 km. and that there is a lower region from 5 km. to 30 km. high. Practically the same discovery was made in England by Watson Watt and his co-workers[4]. In accordance with Mitra's suggestion[5], we propose to call these the *D* and *C* regions.

The following observations may be of interest. The height of the lower boundary of the *C* region is less in summer than in winter; it rises slightly during the night. The *C* region is so strongly reflecting in the summer months that it weakens the reflection from the *D* layer. Hence the *D* layer is usually found in the winter season. When thunderstorms or strong winds are present, the *C* region is very turbulent.

On April 22, 1936, a violent magnetic disturbance was recorded at Cheltenham, Md. On the same day, we observed that the *C* region was fluctuating violently (Fig. 1) and its lower edge approached very close to the earth's surface (1–5 km.). At that time no signals were received upon the 20-metre transmission band from any distant stations.

When the U.S. stratosphere balloon *Explorer II* passed through the 60,000 ft. level, its signals became weak[6]. Our explanation of this phenomenon is that

FIG. 1. Ground pulse and its reflection from the *C* region. On this scale, the *E* layer would appear about three inches and the *F* layer about six inches to the right.

the balloon was actually above the top of the *C* region; hence the signals, which had been reflected back to the earth when the balloon was in the *C* region, were later reflected out into space.

R. C. COLWELL.
A. W. FRIEND.
N. I. HALL.
L. R. HILL.

Department of Physics,
West Virginia University,
Morgantown.
June 22.

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## Stereoisomeric Nature of Oxidation and Fermentation

I HAVE investigated with the aid of the Warburg technique the action of optically isomeric nicotines upon alcoholic (*Torula utilis*, *Saccharomyces exiguus*) and lactic (*Bacterium Delbrücki*) fermentations of glucose dissolved in the external solution; upon oxidation of exogeneous glucose by *T. utilis*, *S. exiguus*, *Oidium lactis*, *Bacillus subtilis*, *B. mycoides*, *Sarcina lutea* and *Bacterium Schützenbachi*; upon oxidation of lactate by *O. lactis* and of ethyl alcohol by *B. Schützenbachi*; and upon respiration of stored glycogen in *T. utilis*, *S. exiguus* and *B. subtilis*. It was found that in these microbes all fermentations are more strongly depressed by *l*-nicotine than by *d*-nicotine, but all oxidations are, conversely, more strongly depressed by *d*-form.

I have also investigated the action of optically isomeric nicotines upon the metabolism of slices of

mouse tissue. *The respiration of the stored glycogen in the liver of the mouse proceeds in two linked phases, the first of which (anaerobic) is more sensitive to nicotine poisoning and accounts for the fact that $l$-nicotine inhibits the whole respiration more strongly than $d$-nicotine.* The oxidation of exogeneous glucose and of lactate in the slices of starved liver are direct, and therefore more sensitive to $d$-nicotine. Glycolysis of the grey substance of the brain in mice is $l$-sensitive to nicotine and of the same order of magnitude as the endogeneous respiration in the liver, and it is therefore *probable that lactic acid production is the limiting* anaerobic link in the latter case.

An extensive comparative investigation has further shown that in green Algæ (*Rhitoclonium fontanum*) and Protozoa (*Palamecium candatum*, *P. Cursaria*, *Euglena viridis* and *Eudorina elegans*) oxidations are direct and $d$-sensitive to nicotine poisoning. At the same time, in the flatworm (*Polyulis nigra*) and in livers of adult pike (*Esox lucius*), frog (*Rana temporaria*), green linnet (*Chloris chloris*), and fowl (*Gallus domesticus*) oxidations are coupled with fermentations, and are more sensitive to the action of $l$-nicotine. It is also interesting that the liver of the chick (3 days old) appears to be primitive in the sense that its oxidation is $d$-sensitive to nicotine and therefore direct.

The precision of the results obtained in the analysis of oxidation and fermentation with the aid of optically isomeric nicotines may perhaps be due to the fact that both the pyridine and pyrrol groups of nicotine enter into the composition of enzymes catalysing carbohydrate breakdown[1] which are therefore in some way specifically destroyed by the nicotine.

A complete account of these investigations will be published shortly.

G. A. GAUSE.

Zoological Institute,
University of Moscow.
June 9.

Warburg *et al.*, *Biochem. Z.*, **282**, 157 (1935).

## Interaction of Heavy Nuclear Particles

SOME time ago, it was suggested that the interaction between neutrons and protons goes on via particles of small mass—electrons (positrons) and neutrinos—somewhat in the same way as electromagnetic interaction (compare Coulomb's law) is transferred by photons[1]. After a recent discussion of the problem by Heisenberg[2], who pointed out the necessity for changing the $r^{-5}$ law to one involving $r^{-7}$ or $r^{-9}$, it seems desirable to perform the calculations for the magnitude of interaction in the most simple manner.

Indeed, the most essential point proves to be the fact of energy transfer *by a pair of particles*, and not by a single photon as in the usual electromagnetic case. For the magnitude of the interaction at the small distances which are of interest, even the statistics of the transferring particles is not important, or even the kind of partners implied (electron and neutrino, or two neutrinos). We have worked with simple scalar equations of wave type, or of the type of Schrödinger's second order relativistic equation. Starting with Fermi's assumption for the interaction between heavy particle and neutrino-electron field ($g\,\varphi_1\varphi_2$), or with a more general expression $\left(g\,\frac{\partial^n\varphi_1}{\partial t^n}\,\frac{\partial^m\varphi_2}{\partial t^m}\right)$ and applying the elegant method of Dirac's quantum electrodynamics, we get for the magnitude of interaction expressions proportional to $\frac{g^2}{r^5}\,I_1(r)$, or $\frac{g^2}{r^{2m+2n+5}}\,I_2(r)$. The integrals $I(r)$ are equal to 1 for $r \ll h/mc$ and vanish at great distances. Thus we get the remarkable result that the interaction depends chiefly on the presence of two particles, just as does the probability for β-decay[3]. If needed, one can introduce the relativistic equations for heavy particles and work with an interaction formula which is very similar to Breit's, but not identical with it.

So far as the order of magnitude is concerned, we can compare the interaction at the distance $r_0$, equal to the radius of a heavy particle, with the self-energy $\mu c^2$. For $r_0 \sim 10^{-13}$, which is assumed to be the most reasonable, the best choice is the energy expression, proportional to $\frac{g^2}{r^{11}}$ or $\frac{g^2}{r^{13}}$, which results from that form of the interaction between heavy and light particles and is that found to be the best for the purposes of β-decay theory[3].

We may note that until now no classical analogy for the field of two particles has been found, so that the above considerations rest on essentially non-trivial results of quantum electrodynamics.

D. IWANENKO.
A. SOKOLOW.

Siberian Physical
Technical Institute,
Tomsk.
June 13.

[1] Ig. Tamm; D. Iwanenko, NATURE, **133**, 981 (1934).
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## Dependence of the Herschel Effect upon the Surrounding Gas Medium

THE Herschel effect—the weakening of the latent photographic image by means of light—is observed, as a rule, in the red and infra-red region of the spectrum. Recent investigations, however, show that under certain conditions the Herschel effect is observed in regions of the spectrum, where usually a normal photographic effect prevails. If, then, the Herschel effect is stimulated by the parallel reaction which accompanies the main photographic process, it is reasonable to suggest that the surrounding gas medium is involved in the reaction.

It was suggested to me by Prof. Narbut that an investigation of the influence of the gases oxygen, nitrogen, hydrogen and carbon dioxide and also of a vacuum upon the Herschel effect would repay investigation. Diapositive plates of the "Photo-Khim-Trust" works of Moscow and Kiev were used. The Herschel effect was obtained by red light (a photographic lamp of 25 candle-power).

Investigations were carried out with seven series of plates, with the following results:

(1) In oxygen, the Herschel effect is much more intensive.

(2) In nitrogen and carbon dioxide, the Herschel effect has almost disappeared.

(3) In hydrogen, the red light gives but a normal photographic effect—additional darkening of the plate. Hence the medium is apparently essential in

the mechanism both of the normal photographic effect, and also the Herschel effect.

Further work with other photographic materials is in progress.

A. VNUKOVA.

Physical Institute,
University, Odessa.
June 29.

### Ozone as a Heating Factor in the Atmosphere

THE vertical distribution of temperature in the upper layers of the atmosphere as affected by ozone has been carefully calculated. Taking the vertical distribution of ozone as found by Götz, Meetham and Dobson, and using new absorption coefficients, it was possible to derive the energy absorbed in the course of one day. Four days were selected to show the yearly change.

The solar radiation below 3000 A. was assumed to be a black-body radiation of 5,910° K.; for all the other wave-lengths, the values given by Abbot were used.

Secondly, the nocturnal radiation has been studied. For each layer the absorption of radiation from the earth and from all the other layers, and the re-radiation of this layer have been calculated. The atmosphere was divided into six layers.

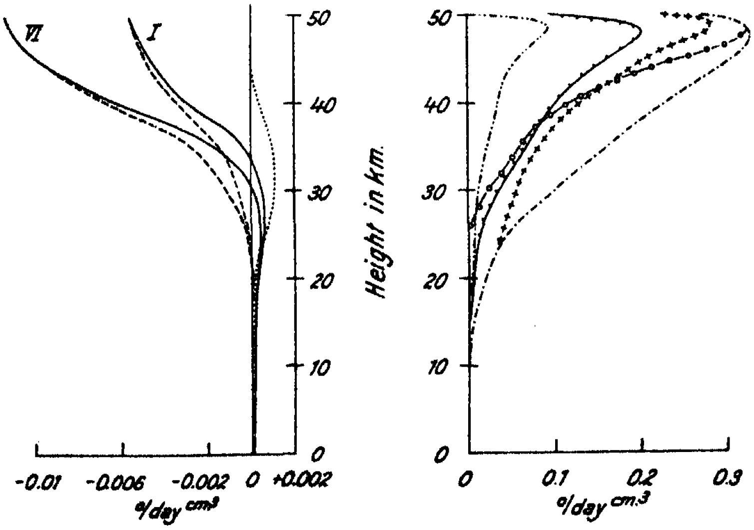


FIG. 1. Left. Cooling effect as affected by long-wave radiation. Two examples for different temperature distribution in the stratosphere are shown. Nocturnal radiation ———. Ozone radiation — — —. Terrestrial radiation . . . . . . .
Right: Heating effect as affected by absorption of solar radiation. March 21 + + + +
June 22 — · — · — · September 23 ┬┬┬┬┬ December 22 — · · — · · — · ·
Ultra-violet absorption only (for June 22) —o—o—o

The results are shown in Fig. 1. It is seen that the heating effect is about ten times the cooling effect at a height of 50 km. Below 25 km. no remarkable influence could be found. Despite the fact that the centre of gravity is situated at 25 km., the maximum lies at 50 km. This demonstrates the importance of an exact determination of the ozone concentration in the highest layers. The maximum corresponds to many assumptions on the constitution of the upper atmosphere.

The results summarized here will be published elsewhere in a more detailed account of these and other phenomena concerning atmospheric ozone.

R. PENNDORF.

Geophysikalisches Institut,
Leipzig. July 4.

### Value of the Acid Silver Nitrate Reaction as a Test of Ascorbic Acid

SZENT-GYÖRGYI observed that the suprarenal cortex reduces silver nitrate, and attributed this property to the ascorbic acid (vitamin C) which it contains[1]. Many workers have observed that this reaction disappears in scurvy and comes back if ascorbic acid is given to the scorbutic animal[2]; the reaction was also used for histological detection of vitamin C, and, the specificity of silver nitrate being increased by acidification with acetic acid, an accurate cytological study of its repartition could be made[3].

The value of the silver nitrate reaction as a test of ascorbic acid has been questioned. Harris and Ray[4], noticing that the liver and the suprarenal medulla, though rich in ascorbic acid, failed to be coloured by silver nitrate, concluded that the absence of this reaction was very little guide as to the presence or absence of vitamin C. Many investigators consider the reaction valueless[5,6]. For example, in a recent review of the question[7], King says: "Silver nitrate staining is not reliable qualitatively or quantitatively as an index of vitamin C in tissues."

In order to clarify this question, we have to consider:

(1) *The occurrence of a reaction with acid silver nitrate.* The reduction of this reagent, without any action of light or heat, is a very specific test of ascorbic acid for the following reasons: the marked reductions are observed only in the organs which by the chemical and biological methods appear to be rich in ascorbic acid (suprarenal cortex, corpus luteum, interstitial cells of the testis and anterior pituitary). In these organs, the cells appear filled with the granules of reduced silver. In organs poor in ascorbic acid, a slight reaction, frequently with a deposit of the silver precipitate at the Golgi apparatus (suprarenal medulla, epididymis), or no reaction except along the walls of the blood vessels, is observed.

When large quantities of ascorbic acid are given to a guinea pig, new reactions appear in the epithelial cells of the intestine, and in the convoluted tubules of the kidney, corresponding chiefly to the increase in absorption and elimination which can be demonstrated by chemical methods.

If guinea pigs are given a diet without ascorbic acid, the reactions disappear quickly, so that after ten days none can be observed in their organs. Biological experiments confirm the absence of ascorbic acid in these conditions.

If ascorbic acid is injected into a guinea pig which is scorbutic and therefore depleted of its reserve, all the reactions reappear within a few hours after the injection.

It may be concluded that all the reactions observed after action of acid silver nitrate are due to ascorbic acid, and, as the histological localizations of the reactions are exactly the same in the animals which, like the rat, are able to synthesize ascorbic acid and

therefore cannot be depleted of it, it is logical to assume that in these animals, too, these reactions are caused by ascorbic acid.

However, there is one exception: the melanin granules in the Langerhans cells and the Malpighian layer of the skin show a reaction which may not be attributed to ascorbic acid, since it persists after methyl alcohol extraction, and does not disappear in the scorbutic guinea pig. This single exception ought not to cause confusion because of the easily recognizable pigment granules.

(2) On the other hand, *the absence of reaction* with acid silver nitrate may indeed be observed in some tissues rich in ascorbic acid (suprarenal medulla, liver . . .), so that a negative result must not be necessarily interpreted as indicating the absence of ascorbic acid.

The chief reason for this failure to reduce silver nitrate is the presence in the organs of factors inhibiting the reduction of ascorbic acid; these 'inhibiting factors' have been described by Huszak[8] in the suprarenal medulla and by de Caro and Giani[9] in other tissues.

In short, the absence of a coloration by acid silver nitrate does not necessarily mean the absence of ascorbic acid, but a positive reaction is a very specific test for this substance.

A. GIROUD.
C. P. LEBLOND.
(Rockefeller fellow in residence, Department of Anatomy, Yale University School of Medicine.)
Laboratory of Histology,
Medical School,
University of Paris.

[1] A. Szent-Györgyi, *Bioch. J.*, **22**, 1387 (1928); *Bull. Soc. Chem. Biol.*, **15**, 694 (1933).
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## Kerr Constants of the Hydrogen Halide Gases

ON the basis of a recent note dealing with the polarization ellipsoids of the hydrogen halide gases[1], it becomes possible to calculate their Kerr constants (Na–*D* line, 20° C., 760 mm.), numbers which should be directly capable of experimental verification.

We take the Boltzmann constant $k = 1{\cdot}371 \times 10^{-16}$ erg per degree per molecule, $T = 293°$ K., $\pi = 3{\cdot}1416$, $N = (6{\cdot}064 \times 10^{23} \times 273)/(22{,}414 \times 293) = 2{\cdot}522 \times 10^{19}$, and $\Delta_{HX} = 0{\cdot}0119$. Further experimental and estimated constants, different for the four halides, are taken as follows:

| Di-atom | $n_D$ | $n_\infty$ | $\mu$ | $b_1$ | $b_2$ |
|---|---|---|---|---|---|
| HF | 1·000140 | 1·000136 | $1{\cdot}58 \times 10^{-18}$ | $0{\cdot}96 \times 10^{-24}$ | $0{\cdot}72 \times 10^{-24}$ |
| HCl | 1·000446 | 1·000435 | 1·06 | 3·07 | 2·30 |
| HBr | 1·000612 | 1·000594 | 0·80 | 4·19 | 3·14 |
| HI | 1·000919 | 1·000883 | 0·41 | 6·24 | 4·68 |

The following relations are applied[2]:

$$K_1 = \frac{2\pi N}{15kT}\left[(b_1-b_2)^2\frac{n_\infty^2-1}{n_D^2-1}\right] = 2{\cdot}629 \times 10^{32}\left[(b_1-b_2)^2\frac{n_\infty^2-1}{n_D^2-1}\right] \quad . \ (1)$$

$$K_1 = \frac{3\,\Delta}{2\pi kNT(6-7\,\Delta)}(n_\infty-1)(n_D-1) = 9{\cdot}477 \times 10^{-10}(n_\infty-1)(n_D-1) \quad . \ (2)$$

$$K_2 = \frac{2\pi N}{15k^2T^2}\mu^2\,(b_1-b_2) = 6{\cdot}545 \times 10^{45}\,\mu^2\,(b_1-b_2) \quad . \ . \ . \ . \ . \ (3)$$

$$K = K_1 + K_2 \quad . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ (4)$$

where the symbols have their usual significance.

The value of $K_1$ by (1) is probably more accurate than by (2), and is independent of the result $\Delta_{HX}$ = a constant. As an approximate check on the theory by which these numbers are derived, however, the value of $K_1$ by (2) is substituted in (1) to obtain a calculated value of $b_1 - b_2$, for comparison with that derived from the estimated $b_1$'s and $b_2$'s given above. Comparison of the last two columns of the following scheme shows the general run of the numbers to be in agreement.

| Di-atom | $K_1$ by (1), $K_2$, $K$ ($\times 10^{15}$) | | | $K_1$ by (2) | $b_1 - b_2$ ($\times 10^{24}$) | |
|---|---|---|---|---|---|---|
| | | | | | est. | calc. |
| HF | 0·015 | (3·922) | (3·94) | 0·018 | 0·24 | 0·26 |
| HCl | 0·152 | 5·662 | *5·81* | 0·184 | 0·77 | 1·18 |
| HBr | 0·281 | 4·399 | *4·68* | 0·345 | 1·05 | 1·16 |
| HI | 0·615 | 1·717 | *2·33* | 0·769 | 1·56 | 1·96 |

$K_{HCl}$ agrees closely, as expected, with the experimental value $5{\cdot}75 \times 10^{-15}$ (*Hansen*[3]). The constants for other wave-lengths can be estimated by this method as required.

It is noteworthy that HCl appears to have the highest constant in the group. As, however, $K_2$ is very sensitive to changes in $\mu$, *this may not be* significant. If $\mu_{HF}$ were as large as 2·0 (Smallwood[3]), $K_2 = 6{\cdot}282$, $K = 6{\cdot}30$, making the gradation continuous from HF to HI.

The present results appear to support the theory put forward in the former communication[1].

C. H. DOUGLAS CLARK.
E. C. HUMPHRIES.
Department of Inorganic Chemistry,
University, Leeds.
June 25.

[1] C. H. Douglas Clark, NATURE [July 18, p. 126].
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## The 2·73μ Absorption Band in Fused Silica

LYON and Ellis in a recent note[1] refer to the absence of the 2·73 μ infra-red absorption band in specimens of fused silica examined by them, and suggest that the band found at this wave-length by previous investigators may be due to an impurity, possibly $CO_2$ or $H_2O$.

It is certainly unlikely, as I have previously pointed out[2], that it can be due to vitreous $SiO_2$, since the absorption coefficient at the centre of this band was widely different in specimens examined by Parlin[3] (K = 0·52), Dreisch[4] (K = 0·33) and me[5] (K = 0·03) and, further, crystalline quartz shows no trace of such a band whilst every other band in fused silica between 1 and 7·5 μ has its counterpart in the crystalline quartz spectrum.

Fused silica, in the course of manufacture, comes in contact with hot carbon and reacts with this with the evolution of gas. This makes contamination with $CO_2$ seem likely, and the band in question does fall in the centre of the region of $CO_2$ absorption at about this wave-length[6]. This suggestion is open to the criticism that the next strong $CO_2$ band, that at $4 \cdot 28\,\mu$, is definitely absent from the fused silica spectrum and that the $2 \cdot 73\,\mu$ band is single and broad while the corresponding structure for gaseous $CO_2$ appears as two doublets under similar resolving power. Nevertheless, solution of $CO_2$ in a solid may radically modify its absorption spectrum.

Another possibility is that the band may be due to another crystalline modification of silica, that is, a cristobalite or tridymite. This seems unlikely as in readings taken on the same set of specimens during one or two years no ageing effect was detected, and further, of specimens cut from one initial melt, some were used immediately without additional heat treatment while one was re-melted to improve its optical homogeneity without any significant difference being introduced in the intensity of this band in the material. A very slight difference was observed between different initial melts in this respect. It would be of interest to know whether the specimens examined by Lyon and Ellis were prepared without contact with carbon, as if this was the case the theory of the $CO_2$ impurity is decidedly strengthened by their result.

D. G. DRUMMOND.

Physics Department,
Armstrong College,
Newcastle upon Tyne.
July 3.

[1] Lyon and Ellis, NATURE, 137, 1031 (1936).
[2] Drummond, NATURE, 134, 739 (1934).
[3] Parlin, *Phys. Rev.*, 34, 81 (1929).
[4] Dreisch, *Z. Phys.*, 42, 426 (1927).
[5] Drummond, *Proc. Roy. Soc.*, A, 153, 328 (1936).
[6] Barker, *Astrophys. J.*, 55, 391 (1922).

## African Honey Bees

SKORIKOW[1] has published a map showing the distribution of the three main types of ordinary honey bees, *Apis mellifera* L., occupying the Palæarctic region, *A. indica* Fabricius, the Oriental, and *A. adansoni*, Latreille, the Ethiopian. Madagascar is inhabited by still another form, *A. unicolor* Latreille. Alpatov, of the University of Moscow, has published statistical studies of South African honey bees, separating two races, called *A. adansoni* and *A. unicolor*, the latter being the form with black abdomen and scutellum. But his *A. unicolor* came from near Cape Town, and were surely not the true *unicolor*, but the race which Buttel-Reepen (1906) named *intermissa*. This insect differs from *A. unicolor* in having bands of tomentum on the abdomen, these being usually conspicuous, but sometimes not evident, when the specimens are worn, or the abdomen is much contracted.

I have just examined the honey bees of the 1933–34 expedition by Mr. and Mrs. J. Ogilvie to South Africa, and I find eight *A. adansoni* (from Bot River, Belmont, Kirstenbosch, Upington and Seeheim) and fifteen *A. adansoni intermissa*, from Lions Head, Cape Town and from Bot River, but the majority from an uncertain locality, owing to a mistake in labelling at the British Museum. From the expedition of 1931, I find four specimens from Victoria Falls, which I had overlooked. Three are ordinary *A. adansoni*, but of two collected by my wife on Livingstone Island, one is *A. adansoni*, and the other, abruptly different, is to all appearances *A. unicolor*, though the surface of the abdomen is duller than in a specimen from the Seychelles Islands.

No doubt the African bees are being crossed with different forms of the European species, introduced by man; hence it is desirable that material should be collected as soon as possible in all parts of Africa and deposited in the British Museum or elsewhere, where it will be available for minute statistical studies, such as those of Alpatov. Enderlein, in his revision of *Apis* (1906) distinguishes the African forms by the smaller size (body 10–12 mm. long, 3½ mm. broad, front wings 8–9 mm. long) and then divides them into those with black abdomen (*unicolor* and *intermissa*, as just given, and also a form *friesei*, Buttel-Reepen, differing from *intermissa* by the average smaller size and the yellowish-brown scutellum), and those with a largely fulvous or yellow abdomen, the true *adansoni*, closely resembling the familiar Italian race. The variety *friesei* comes from Mombasa, East Africa.

T. D. A. COCKERELL.

University of Colorado,
Boulder.
June 29.

[1] "A New Basis for a Revision of *Apis*", 1929.

## Vernalization

THE phenomenon of 'vernalization', namely, the acceleration of ear formation in winter varieties of cereals by exposing the germinating seed to low temperature, is now well known[1]. The underlying cause of this effect of low temperatures is by no means clear. Enzymatic changes in the fruit external to the embryo have been postulated by Richter and others. Experiments to test such possible changes or hormone effects have been performed by Krasnoseljskaja-Maxomova in which endosperm of winter and spring varieties has been interchanged. Similar experiments have been repeated by Sereiskii and Sluckaja, and interchange of embryos has also been tried. The former investigator claims positive results which, however, the latter investigators failed to substantiate.

Experiments recently carried out by us have shown conclusively that excised embryos separated completely from the endosperm and grown on agar containing 2 per cent glucose and mineral nutrients alone can nevertheless be vernalized in the same way as complete 'seeds'. Such separated embryos kept at 1° C. for six weeks and then planted out produced normal plants earing ten weeks later, whereas similar embryos kept at 18° C. until they had reached the same stage in development (coleoptile developed, but first leaf not emerged) showed no signs of 'shooting' after a further ten weeks of growth.

It would appear therefore that the 'cause' of vernalization by low temperature is entirely inherent in the embryo, and is not dependent in any way on the metabolism of the endosperm or aleurone layer.

F. G. GREGORY.
O. N. PURVIS.

Research Institute of Plant Physiology,
Imperial College of Science and Technology,
London.

[1] Vernalisation and Phasic Development of Plants. Bull. 17 Imperial Bureau of Plant Genetics.

## Points from Foregoing Letters

In further development of her working hypothesis of protein structure, according to which a network ('cyclic') structure is postulated in place of the branched chain ('polypeptide') structure, Dr. D. M. Wrinch calculates the approximate energy of formation of 'cyclol' molecules from polypeptides. The calculations suggest that the process of linkage is facilitated if the appropriate groups are in the imide form, —C(OH)=N—, a state which may be brought about by the action of certain enzymes. F. C. Frank, commenting on Dr. Wrinch's theory, estimates the energy balance in the process and, to account for the deficiency in the necessary energy, postulates the existence of an additional source of energy similar to that provided by the strain in the side-chain cross-linkages found in keratin. He further points out that hydration also provides part of the necessary additional energy, and helps in explaining certain properties of the proteins, observed in 'degeneration' and 'denaturation'.

Criticizing Prof. Hale Carpenter's description of the behaviour of the African insect *Charaxes*, Prof. H. E. Armstrong states that an insect cannot *deliberately* hide itself, and suggests that 'mimicry' may be caused by changes in food, temperature, or by hybridization. In reply, Prof. Hale Carpenter gives further examples of *deliberate* action and of mimicry which cannot be explained by the factors suggested by Prof. Armstrong.

Indications of the occurrence of earthquakes and of accompanying seismic sea-waves (tsunamis) in Ordovician times (Caradog age) are described by Dr. A. Lamont, from observations of strata in the Irish Free State. These may involve revision in the interpretation of certain features, such as crush-conglomerates and intrusive tuffs, the origin of which has hitherto been ascribed to other agencies.

Miss H. D. Megaw and Prof. F. Simon have determined the approximate values of the density, compressibility and thermal expansion of ordinary and heavy hydrogen (deuterium) in the solid state (at 4·2° K.), by comparison with helium, in order to show the influence of the 'zero point energy' (inferred from Planck's second quantum theory) on those properties.

Part of the oxygen consumed by certain luminous bacteria (*Photobacterium phosphoreum*) is apparently directly connected with the amount of light emitted. K. L. van Schouwenburg and J. G. Eymers find that, at 16° C., about 500 molecules of oxygen are used per quantum of light emitted, but the efficiency of the light-emitting process varies with conditions.

Some further notes on the behaviour of and variations in the ionized *C* layer of the atmosphere (5–30 km. high) are given by Prof. R. C. Colwell, A. W. Friend, N. I. Hall and L. R. Hill. The authors explain the weakening of the radio signals from the stratosphere balloon *Explorer II*, when it passed through the 20 km. level, as due to its having reached the top of the *C* layer ; a portion of the radio waves would then be reflected outwards into space, instead of being reflected towards the earth.

Of the two optically active forms of nicotine, Dr. G. A. Gause finds that the lævo-form has a greater inhibition power upon the fermentation of glucose by various microbes than the dextro-form. Oxidation processes on the other hand are more strongly inhibited by the dextro-rotatory nicotine. The author also finds differences in the action of the two optically active nicotines upon similar processes taking place in green Algæ and in various animals.

Formulæ for the magnitude of interaction between neutrons and protons (via particles of small mass—positrons and neutrinos) have been worked out by D. Iwanenko and A. Sokolow, with simple scalar equations of the type of Schrödinger's second order relativistic equation. The process is supposed to be somewhat on the lines of electromagnetic interaction.

Mrs. A. Vnukova finds that the antagonistic action exerted by light of certain wave-lengths, which weaken the latent image on a photographic plate ('Herschel effect'), is more effective in the presence of oxygen and becomes negligible in nitrogen or carbon dioxide.

From the difference between the energy absorbed by ozone from sunlight during the day, and that lost by radiation during the night, allowing for the absorption of radiation from the earth and from other layers, R. Penndorf calculates the heating effect due to the presence of ozone in various layers of the atmosphere. The calculations indicate a maximum heating effect at a height of 50 km. where the heating is about five times the cooling effect.

Having investigated the conditions under which silver nitrate can be relied upon as a test for vitamin C (ascorbic acid), A. Giroud and C. P. Leblond conclude that while the absence of a coloration by acid silver nitrate does not necessarily mean the absence of ascorbic acid, a positive reaction, with few exceptions, is a specific test for this substance.

In a test of the theory of the polarization ellipsoids of the hydrogen halide gases, Dr. C. H. Douglas Clark and Dr. E. C. Humphries have estimated the constants $K$ for these gases occurring in the Kerr (magneto-optic) effect. These numbers are capable of experimental verification, and appear to confirm the theory.

In explanation of the origin of the absorption band (wave-length $2\cdot73\,\mu$) in the infra-red spectrum of certain specimens of fused silica, Dr. D. G. Drummond favours the suggestion that it is due to the presence of carbon dioxide, with which the silica may readily become contaminated during the process of manufacture.

With reference to the various forms of African bees described, Prof. T. D. A. Cockerell records several specimens of *A. adansoni* and *A. adansoni intermissa*, and one specimen of *A. unicolor* in the British Museum collection. He directs attention to the desirability of collecting further material for genetic studies before the African bees become crossed with different forms of European bees introduced by man.

Dr. F. G. Gregory and O. N. Purvis have carried out experiments with embryos of cereals separated from the rest of the seed and grown on agar (containing 2 per cent glucose and mineral salts) kept near the freezing point (1° C.) for six weeks and then planted out. They find the same subsequent acceleration in the ripening process (vernalization) as in the case of whole seeds similarly treated, which indicates that the cause of 'vernalization' is inherent in the embryo.

# Research Items

## Physical Characters of the Bedouin

DR. WILLIAM M. SHANKLIN, of the American University of Beirut, in the summer of 1934 made an expedition into the Syrian desert with the object of studying the members of the Rwala tribe, who appear to conform to the definition of a Bedouin as "a nomad who breeds and keeps camels and . . . able to trace his descent from certain recognized pure-bred Bedouin tribes". The Rwala are a subdivision of the Al-Glas, one of the major branches of the Anazeh nation, who are found more especially in the Hejaz and Syrian deserts. In recording his results (*J. Roy. Anthrop. Inst.*, **65**, Pt. 2; 1935), Dr. Shanklin summarizes the evidence of the blood-groups, published more fully elsewhere, as showing a high percentage of blood group *O*, indicating that the Bedouin belong to a race of very considerable antiquity. The American Indians also belong to the blood-grouping *O*. The Rwala in their physical characters have retained features which are regarded as having characterized the primitive Mediterraneans; but elsewhere in the Near East, Egypt, Arabia, etc., this type has been overrun by the brachycephalic element, to which observers have directed attention. Thus among their average measurements are: head-length, 191 mm., breadth, 144 mm.; cephalic index, 75 (range 67 to 82); nasal height, 55 mm., nasal breadth, 35 mm.; bizygomatic breadth, 130 mm.; bigonial breadth, 106 mm. They are white, but have brown, or brunet skin, straight black, or brown, hair, brown eyes and high, straight, narrow noses. If the view that holds that the agglutinogens *A* and *B* are of relatively late origin is accepted, the evidence of the blood-groups would corroborate the evidence of physical character in showing that the Bedouin may well be representatives of the primitive Mediterranean race, who have preserved their racial character over a long period. On the other hand, the earliest known skulls of the American Indians, as pointed out by Hooton, are also dolichocephalic, and this, with their blood-grouping, accepting the conclusion of their Asiatic origin, may point to the fact that they and the Bedouin are the descendants of a remote, but common, primitive stock.

## New British Bird

THE rather remarkable number of scarce American birds that have appeared in the British Isles in the past two years—yellowshank, American pectoral sandpiper, and others—is further increased by the recent addition to the British list of Audubon's little shearwater (*Puffinus assimilis-l'herminieri* Lesson) which J. J. Harrison describes in the July issue of *British Birds* as of the West Indies form. The bird was found alive on the beach at Bexhill-on-Sea by Mr. W. E. Dance on January 7, being mobbed by gulls. When taken home it soon collapsed and died. The record is of importance because Gould recorded a specimen from Dover, but owing to insufficient verification it was never accepted, and he himself excluded it from his later works on British birds. It was in the April issue of *Ibis* that Mr. W. P. Lowe described another new British bird, the Franklin's gull, which was watched among a flock of herring and black-headed gulls on Exmouth beach, Devon, on January 19, 1936. The British razorbill has recently had its status as a separate sub-species established owing to comparisons of British with Swedish and Greenland skins showing that the British birds are definitely smaller in measurements than the Continental ones and that the Faroe birds belong to the British race; hence the alteration in nomenclature to *Alca torda britannica*.

## Periodicity in Algæ

IN certain districts of India, the regularity of the seasonal changes, especially as regards temperature and rainfall, offers an opportunity for the study of algal periodicity which would never arise under the variable conditions of the English climate. M. S. Randhawa (*Proc. Indian Acad. Sci.*, **3**, No. 5, 1936) has now followed the periodicity of the freshwater Algæ in the Saharanpur District over the greater part of two years, and has obtained some very definite results. Many of the Algæ rest through the hot dry summer months in the form of thick-walled oospores; these germinate with the rain of the Monsoons and continue to grow vegetatively through the cooler autumn and winter months. With the rise of temperature in the spring a period of sexual reproduction sets in, ending with the production of thick-walled oospores. The gradual rise in temperature after a long period of vegetative growth is evidently particularly favourable to sexual reproduction, which is apparently strikingly prolific. Under these more consistent climatic conditions, the Algæ fall into step with the seasons and thus show marked periodicity, which is masked in more variable climates by small changes which affect the algal growth. It is of interest that the filling up of the ponds and streams by flood waters after the dry season is accompanied by a peak in the development of Myxophyceæ, an effect which has also been recorded in British Lake District waters when much debris is carried down by heavy rain.

## Electric Heating of Garden Frames

A PAPER by Dr. J. Grainger and T. F. Armstrong (*Gardeners' Chronicle* of June 13 and 20) shows that the use of soil heating by buried electric cable is quite satisfactory for raising seedlings of green crops such as lettuce and endive, for the forcing of special crops, as mint and rhubarb, but not for root crops such as radishes, which tend to flower rather than to swell their roots in heated soil. A valuable table showing detailed consumption of electricity for raising the soil temperature by varying amounts is given. Heating cables have also been used to heat the air within deep propagating frames, and although this was successful from a horticultural point of view, it requires an average of 1·06 units of electricity per cubic yard per day to raise the temperature 10°–15° F. above that outside the frame. With electricity at ½*d*. per unit, this works out about twice the cost of heating similar structures by a coke fire in a hot-water system. The paper also shows that heating the soil may aggravate the effects of crown rot disease of rhubarb, during forcing.

### Autopolyploidy

THE evolutionary significance of autopolyploidy, based on the numerous cases now investigated, has been considered by Dr. A. Müntzing (*Hereditas*, 21, 263). About one hundred species are now known to show intra-specific variation in chromosome number, autotetraploidy being the most common condition. Such tetraploids usually show *gigas* characters, being generally stouter and slower in development. Both morphological and physiological changes result from the larger cells, but hexaploids frequently and octoploids generally show dwarfing, indicating that the optimum chromosome number has been exceeded. Intra-specific tetraploids are also ecologically different from the diploids, and they usually have a different geographical distribution, being generally, but not invariably, more northern. Such polyploids appear to be generally more hardy and adapted to a northern, alpine, xerophytic or coastal habitat, into which the corresponding diploid does not extend. Experimentally induced autotetraploids show essentially the same features as natural ones. Chromosome association at meiosis is the same in both, ranging from almost complete bivalency to almost complete quadrivalency. Wild autopolyploid races are usually fertile, while experimentally induced ones generally show poor fertility. This difference may be accounted for by the effects of natural selection. The perennial species in a genus have a higher average chromosome number than the annuals. Autopolyploidy has played an important role in the evolution of higher plants.

### Tokyo Earthquakes in 1935

WE have received the last of the quarterly *Seismometrical Reports* for 1935 issued by the Earthquake Research Institute. These refer only to earthquakes that were sensible in Tokyo. After the great earthquake of 1923, a system of eight seismological stations was founded in and around Tokyo. During the year 1924, 60 earthquakes were felt in Tokyo, and the records obtained were sufficient to determine the epicentres of 52 and the focal depths of 42 earthquakes. In 1935, the number of stations had risen to thirteen, the number of sensible shocks was 78, the epicentres of all and the focal depths of 67 earthquakes were ascertained. In Tokyo itself, most of the shocks (55 in number) were just perceptible, and none at any station reached even semi-destructive strength. The mean depth of the foci was 28 miles, the greatest depth measured being 75 miles.

### Oxidation-Reduction Potential

COMPARATIVELY few accurate measurements of the potentials of oxidizing-reduction systems have been made, one of the main difficulties being the ease of hydrolysis usually observed with the higher valency ion. One of the best investigated systems is that of the thallic and thallous ions, $Tl^{\cdot\cdot\cdot}/Tl^{\cdot}$, which was investigated in 1905 by Abegg and J. F. Spencer. Later investigators showed that the potential appeared to vary considerably with the nature of the anion, doubtless owing to the formation of anion complexes. Two recent investigations of the electrode, by J. R. Partington and H. I. Stonehill (*Trans. Faraday Soc.*, 31, 1357; 1935) and by A. A. Noyes and C. S. Garner (*J. Amer. Chem. Soc.*, 58, 1268; 1936), have included precautions to avoid this effect. The former investigators used the sulphates in sulphuric acid solution, and the latter the nitrates in nitric and perchloric acids. The two values for the normal potentials, 1·20–1·22 volts, and 1·230 volts, respectively, are in satisfactory agreement. Since there is little likelihood that complexes are present in the nitrate and perchlorate, the results show that the formation of sulphate complexes by thallic sulphate is not very extensive. An interesting feature of the work of Noyes and Garner was the use of ozonized oxygen for the oxidation of the thallous to the thallic salt in concentrated nitric acid, thus avoiding the introduction of extraneous substances into the solution.

### Experiments with Neutrons

C. H. COLLIE and J. H. E. Griffiths (*Proc. Roy. Soc.*, A, 155, 434) have investigated the absorption of fast and of slow neutrons using an arrangement in which the effect of mere scattering was largely eliminated. The absorption cross-sections for fast neutrons were nearly the same ($1-1\cdot5\times10^{-24}$ cm.$^2$) for a number of elements tried. The experiments with detectors sensitive to slow neutrons showed an increase in activity when the absorber was put in, and this probably means that new slow neutrons were produced by collision of the fast neutrons with the absorber nuclei. S. Kikuchi, H. Aoki and K. Husimi (*Proc. Physic. Math. Soc. Japan*, 18, 115) have studied the production of $\gamma$-rays from numerous substances bombarded by fast neutrons ($2\times10^6$ e.v.). Slow neutrons were excluded from the specimen. The cross-sections calculated for $\gamma$-ray production vary unsystematically with atomic number, the absolute values are of the order $5\times10^{-25}$ cm.$^2$, and it seems that $\gamma$-ray production is responsible for a considerable part of the absorption of fast neutrons by many elements. The $\gamma$-ray energies seem to be fairly similar in all cases, but they are not monochromatic. The $\gamma$-rays excited by slow neutrons appear to be of a different type, they are usually harder, and are to be ascribed to the capture radiation associated with nuclear transformations.

### *Statistical Research Memoirs*

THE first volume of a new publication entitled *Statistical Research Memoirs* appeared in June of this year, edited by Prof. E. S. Pearson and Dr. J. Neyman, and published by the Department of Statistics at University College, London. The *Memoirs* will contain only papers prepared in that Department. The series will not be strictly periodical, but it is hoped that a volume of more than 150 pages will be issued about once a year. The price is 15*s.* a volume, or 12*s.* 6*d.* to those who signify in advance their intention to purchase the next volume. The *Memoirs* are intended to advance the general theory of statistics, which at present is not yet on firm foundations. It is the ambition of the Department to contribute towards the establishment of a theory of statistics on a level of accuracy which is usual in other branches of mathematics. The present volume contains seven papers, two by J. Neyman and E. S. Pearson, and the others by P. P. N. Nayer, B. L. Welch, P. O. Johnson and J. Neyman, P. V. Sukhatme, and R. W. B. Jackson. All of these deal with closely related subjects, connected with the well-known methods of Neyman and Pearson for testing statistical hypotheses. The *Memoirs* will, as a general rule, be restricted to the general theory. Papers dealing with the applications of statistics serve their purpose best when they appear in journals devoted to the particular fields of application.

# Forestry in Kenya

THE annual forest report for 1934 for the Colony and Protectorate of Kenya (Nairobi: Government Printer, 1935) is of interest on the subject of reservation of forests. The total reserved forest area in 1921 was 3,207 square miles; in 1934 it amounted to 4,711 square miles. During this period, some areas of reserve forest have been given up.

From the report, the reasons for giving up areas of forest already reserved is not clear. The common reason for such returns to the Civil Department is that the land is required, and can be more profitably used for, agriculture. This is not given as the reason in Kenya. The Conservator writes: "In making these excisions from the forest very careful consideration is given to each case, and no land that is thought to be of value to the forest, climatically or commercially, is given up". It is somewhat difficult to visualize the uses to which land of no value to the Forest Department can be put. In spite of this statement and the admission that there is a certain amount of anxiety in the Colony as to the adequacy of the forest area, "and a feeling that this area is being seriously diminished by constant excisions", the report states that, during the year, the Kenya Land Commission recommended that approximately 13,500 acres should be excised from forest reserves in settlement of various claims. The Department considers that "little real damage was done"; but the Commission itself records in its report that "We agree with the conclusion that the items shown in the schedule [that is, the land that was surrendered] should be regarded as the limit of sacrifice which the forest should be required to suffer".

This appears to be strange reading. In the administration of a country, nowadays, a clear understanding of the position played by the forests, both economic and climatic, should be possible and form part of the policy of governance. Either the forest is required to fulfil these vital interests of the population or it is not. Once the maintenance of the water supplies of a country, provision for local requirements of the population, and such commercial interests as may be considered advisable to provide for have been arranged, the rest of the forests may be sacrificed, in other words, felled and suffered to disappear with equanimity in the interests of other and more serviceable utilization of the land. But such disposal of the land does not and should not entail "the limit of sacrifice which the forest should be required to suffer". It would appear in Kenya that, for some reasons not apparent in the report, land previously forming forest reserves is being alienated at some danger to the maintenance of a correct proportion of forest, even though there appears to be some 800–1,000 square miles still to reserve, lying mainly within the native reserves of Meru, Masai, Cherangani and Marakwet.

The cuts in expenditure account for much during the last few years; but in view of the fact that there has been an expert forest service in Kenya for some considerable period, it is depressing to read that "it was still impossible to detail an officer or officers for the special work of enumerations and compilation of working plans; divisional staffs cannot be expected to make much progress in such important work".

The chief work in connexion with regenerating the forests is by exploiting the forest produce indigenous to the areas it is desired to plant, and then, by means of controlled shifting cultivation or *toungya*, replanting suitable trees in regular plantations. In such work, as the report states, definite plans are required. But plantations will not replace square miles of indigenous forest, even if they are putting back a greater potential tonnage than that of the present annual cut. To know what is standing in the forests should be the vital factor antecedent to exploitation. Until this factor has been ascertained, it appears irrelevant to consider markets available for export.

# Rural Custom in Civilized Communities

IT is an interesting coincidence that the claims of ancient custom and conservatism in civilized communities as worthy of observation and record should be urged almost simultaneously from three different sources, of which one is far removed from the other two—England, France and South Africa.

Mr. R. U. Sayce in *Man* of April, emphasizing the importance for anthropology of the study of civilized, as well as uncivilized, peoples, refers as a case in point to the remarkable variety shown in British agricultural implements in response to local conditions and requirements. Not all, indeed, are of British origin. Some have been introduced by foreign workmen, as, for example, the implements used in cutting peat near Manchester and the implements of the sugar-beet industry, both of which are of Dutch origin. The bill-hook affords an interesting example of this variation. Mr. Sayce figures no less than forty-eight distinct varieties of the bill-hook, all of which are now manufactured, and are in use, in different parts of England and Wales. That Mr. Sayce is not entirely ploughing a lonely furrow is indicated by the fact that in the same month of April a collection of implements illustrating the changes in agriculture during the last hundred years was presented to the Colchester and Essex Museum.

Apart from its cultural value, the study of traditional types of agricultural implements may have a distinctly practical bearing on the work of the archæologist in affording a clue to the character and purpose of a find of unusual or previously unknown type. This latter function of the study is stressed by M. L. Franchet in an introductory sketch of agricultural ethnography (*Revue des Sciences*, 111, April

11, 1936), in which he dwells on continuity in type as a regional characteristic. Analogies to archæological finds, he points out, have been sought among primitive peoples, geographically remote, and often have led to erroneous results; whereas investigation in the area in which they were found, among the people of to-day, would have revealed in many instances the identical type, or a derivative, in everyday use. M. Franchet himself has interpreted his archæological finds by this method with illuminating effect, and he has also traced modern implements back to their origin in the bronze age. His researches in the forest of Montmorency find an ancestry for certain implements which leads back to the stone age, while the equipment of viticulture and wine-making goes back, with the industry, to Gallic times, though, of course, not all the implements in use are of an equally remote origin. There is a pregnant reminder that the conversion of the sword into a ploughshare is more than a rhetorical trope in the observation that in primitive conditions the weapons of war do become the implements of peaceful occupations when hostilities cease.

A legitimate pride of descent and a half-humorous, but wholly determined, practice of traditional ways of doing certain things is attributed to the Cape population of Dutch descent in a record of surviving customs by Eric Rosenthal ("Old Time Survivals in South Africa". Government Printer, Pretoria, 1936. Pp. 38). The survival of so much that, on a superficial view, is obsolete may seem remarkable in a community that is now essentially up to date, and of which some of the industries are highly mechanized. To some extent this may be due to a racial pride and race consciousness; but the real explanation lies deeper. It is part of an enduring environmental adaptation. The clue is afforded by the survival of the old ox-wagon, virtually unchanged since its first introduction from Holland by Jan van Riebeck in 1632, except for the addition of a brake in the eighteen-sixties, yet of which there are more than a hundred thousand in use in South Africa side by side with the automobile. This apparent anomaly may be explained by the fact that the ox wagon has been the efficient cause in the development of the characteristic South African civilization. When built in the traditional way and from the traditional materials, it is still the best, and indeed the only, means of transport which is fully adapted to the geographical conditions and the social and economic needs of the country. One useful feature of ox-wagon travel, the 'outspan' for night camping, still found in every community, serves both the old and the modern need in a country where distances are great and hotel facilities few.

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# Empire Surveys

FORMERLY it was difficult for surveyors, more or less isolated in the Dominions and Colonies, to keep in touch with the advances in technique which are constantly occurring both as regards instruments and methods, cut off as they are from their fellow surveyors.

The institution of periodical conferences, held in the heart of the Empire, under the auspices of the Colonial and War Offices, has changed all this. Surveyors from different parts of the Empire meet and get in touch with each other as they never did before. Nothing but good can result from this. There has also been established a quarterly journal, the *Empire Survey Review*, devoted to survey technique and the discussion of matters of interest to the surveyor. At last year's conference, all the Dominions (except New Zealand), India and Colonies possessing survey departments, were represented, as well as many British scientific societies and universities.

At the conference, the report of which has lately been published*, some forty papers bearing on all branches of surveying and dealing with the latest instrumental developments were read and discussed. Of these, no less than eight dealt with matters connected with air survey, showing the importance now attached to this branch of the subject.

From such a mass of matter it is not easy to single out for notice particular subjects. Major M. Hotine has an interesting paper on signals for triangulation. Sufficient attention is not always paid to signals where accurate work has to be done. As the author points out in the case of opaque signals made of wood, it is very necessary in order to avoid warping and the movement of the signal due to the drying of material after erection, that they should be made of seasoned timber, instead of, as is usually done, from wood cut on the spot. Incidentally, Major Hotine points out that if primary triangulation is undertaken at all, it should be of first-class order and not "only good enough for immediate purposes". Someone is sure to want to extend it in the future, in which case it may have to be done all over again. Therefore every precaution should be taken with the observations, the best instruments should be used and suitable signals well centred over the marks, or the work will not conform with first-class triangulation. A new type of electric night projector is being brought out by Messrs. Cooke, Troughton and Simms, Ltd., which can be worked by a 12-volt accumulator such as is carried on a motor car. We understand it is being used by the Ordnance Survey in the re-triangulation of Great Britain now in progress.

Many papers are read chiefly with the view of encouraging discussion. For example, a new instrument is experimented with; it is of considerable advantage to know what the experience of others has been with an instrument of the kind. When we consider how grudgingly money is allotted for survey purposes in Great Britain, it is astonishing to read that more than £6 per acre is spent on the survey of Georgetown and Malacca in the Federated Malay States. The value of survey out there is evidently known and appreciated.

Perhaps one of the most remarkable papers read before the conference was by Lieut. E. H. Thompson, R.E., on "An Automatic Plotting Machine for Air Photographs". This machine is from the designs of Mr. Fourcade, who has been working at this difficult problem for some years. Lieut. Thompson has

* Conference of Empire Survey Officers 1935. Report of Proceedings. (Colonial No. 111.) Pp. vi+377+36 plates. (London: H.M. Stationery Office, 1936.) 20s. net.

constructed a most ingenious model from Meccano to illustrate the working of this complicated instrument. Without something of the sort, it is very difficult to understand how it functions.

Brigadier MacLeod pleads for the co-ordination of African surveys. He points out that some kind of arrangement should be come to among the various nations possessing African territory with the view of adopting uniformity of scales and projection of maps, before it is too late. So far, this has been achieved only in the case of the International "Carte du Mond" on the 1/1,000,000 scale. He also urges the adoption of the metric unit. The progress of aviation has made this necessary since the airman passes so quickly from one territory to another. Unless something is done, Africa of the future will be saddled with a multiplicity of scales, styles and projections. As no other nation is likely to adopt the British units of measurement, unless we change to the metric system, yet another complication will be added to the map difficulties of the airman.

Before the conference terminated, resolutions were passed recommending that a central pool of survey instruments should be formed from which Dominions and Colonies could borrow on certain terms; that the *Empire Survey Review* should be continued notwithstanding some loss, as a means of keeping up the standards of surveying technique; a resolution emphasizing the necessity for basing all categories of survey on a proper geodetic foundation; a resolution recording the opinion of the conference as to the value of its proceedings for the discussion and interchange of views on the improvement of survey technique. The conference also decided that it is desirable to hold triennial conferences lasting for two weeks.

H. L. C.

# Electrical Interference with Broadcasting

THREE years ago the Institution of Electrical Engineers appointed a special committee to consider the trouble caused by the interference of various kinds of electrical devices with radio reception. This nuisance has been gradually getting worse owing to the growing sensitivity of modern receivers. The report has now been published (Inst. Elec. Eng., Savoy Place, W.C.2. 6*d*. post paid) and was commented upon in NATURE of August 1. The committee was fully representative of all sections of the industry on both the radio and engineering sides.

A method of measurement of interference has been agreed upon, and instruments have been developed capable of indicating with sufficient accuracy the amount of interference caused by much of the electrical apparatus which causes trouble. The technical position has been cleared up, and it is considered that no undue extra expense will be involved in the design and construction of apparatus that will bring the interference caused within an acceptable standard. The apparatus which is likely to cause the most interference is classified as follows: (1) lifts in buildings; (2) trolley-buses and trams; (3) household electrical appliances; (4) small electric motors; (5) 'neon' display signs; (6) certain rectifiers for power plant and (7) electro-medical apparatus. In an appendix to the report, a brief account is given of the researches undertaken in connexion with these seven groups.

In addition, although there is at present little interference with ordinary broadcast reception due to the ignition systems on motor-vehicles, it is probable that, unless corrected, it will interfere with the television reception of the future. There are other causes of radio interference such as electric signalling gear on railways, but at present they produce only minor effects. Real progress has been made in finding the most effective methods of correction in each of the seven groups given above. As a result of Post Office activity, a considerable amount of radio interference correction has been taking place during the last few years.

The first case where radio interference correction was in effect made compulsory was that of traffic signals. The Ministry of Transport now requires all traffic signals to be fitted with components which effectively prevent interference. This was achieved without much difficulty. The second case was that of trolley-buses, where much practical progress has been made. It is now clear that the various technical aspects of the problem are approaching solution, and it is necessary to consider whether compulsory powers should be conferred on some authority so that radio interference may be suppressed in those cases where it can only be done with the help of such an authority. The manufacturers of appliances and plant definitely support the view that there should be some recognized 'mark' which could be affixed to all portable apparatus as a guarantee that the apparatus complies with non-interference requirements. They consider that the sale of appliances which do not meet those requirements should be prohibited. It is essential that imported articles should be subject to the same regulations as home-produced articles and should bear the 'mark'. It is only through legislation that this question can be dealt with successfully. As a rule, it is not the man who buys and uses the apparatus, but his neighbour, who suffers from the resulting interference.

In view of the fact that it is generally cheaper to incorporate suppression devices in the original design of the equipment than to fit them after installation, it is recommended that compulsory powers should be conferred on some authority. It is anticipated that there will be only a small number of owners of interfering equipment who will refuse to apply remedial measures. It is recommended that the Electricity Commissioners should be the authority to issue regulations regarding both new and existing equipments and that the Post Office be charged with enforcing them. British Standards Specifications have already been issued giving the standard ratings for condensers, 'resistors', inductors and similar apparatus for incorporation in suppression devices. The specification for a standard interference-measuring instrument will cover the characteristics and performance requirements recommended by the Special International Committee on Radio Interference. It will include a detailed design for a portable instrument which will enable manufacturers to

ascertain what values of components should be used to reduce interference within the prescribed limits.

In a statement made by Mr. C. C. Paterson, the chairman of the Committee, concerning the report, he points out that should the regulations be put into force, the normal procedure would be very much as at present. There would not be an army of inspectors searching out for trouble. Action would only be taken by the Post Office on receipt of a complaint of interference, and these complaints would become fewer in number as new apparatus bearing the 'mark' came into use.

# Industrial Development in South Africa

THE Department of Commerce and Industry of the Government of the Union of South Africa has published a review of the material, scientific and educational progress made in connexion with the development of industry during the twenty-five years up to 1935*. Primarily, its purpose is to give an accurate picture of the conditions and prospects in what are described as the secondary industries, for agriculture and mining are otherwise dealt with and are only referred to in so far as they have a bearing on the other and less firmly established industries. The information it contains as to the conditions, facilities, costs, etc., in various districts and the progress of the numerous industries which have been established will also be found to supply a valuable scientific interpretation of the facts for the use of those who are or may become interested in the industrial future of the country.

In round numbers, the following figures give a picture of the expansion that has taken place in the twenty-five year period—employees have increased from 66,000 to 195,000, horse-power from 140,000 to 1,400,000, and total wages from 4 to 27 million pounds. The classes of industries dealt with and analysed statistically include fuel industries, iron and steel production, heavy chemicals and food production (sugar, wines and fisheries), together with other important developments which are taking place in connexion with the introduction of such manufactures as cement, pottery, clothing and textiles.

In these changes, the importance of research appears to be fully realized, and it is being fostered as an aid and guide in obtaining the best results. At Mount Edgcumbe, the sugar industry has, at a cost of £13,000, established an experimental station, which is run at an annual charge of about £9,000. On the agricultural side, its main function is the search for new canes of superior sugar content and of higher resistance to disease. There are also a chemical side, dealing with manufacturing methods and processes, and an engineering section to investigate mechanical problems.

The Union Government conducts research in connexion with the fisheries, investigating life-histories and the intensity of operations and engaging in technological research on canning, smoking and other processes. Marine biological work is carried on in the specially designed research ship *Africana*, which took over the duties in 1931, while shore investigations in this department are conducted at the Laboratory and Aquarium at St. James, near Cape Town.

In a country making rapid advances towards industrialism, and possessing rich stores of natural wealth, much special research is necessary in order to ascertain the best methods of making use of and adapting its resources to its own needs and that of export trade. Such work is being done on the coal supplies, the phosphates, the clays and other materials offering scope for increased usefulness. The use of gas, for example, might be greatly increased and developed.

The value of standardization has been recognized, and the editor takes the opportunity of impressing on his local readers its importance in eliminating ambiguous and misleading descriptions, in preparing dimensional standards and in specifying physical and chemical properties of materials, methods of testing, and safety codes. The South African Standards Institution, which is associated with the British Standards Institution, is conducted by a main committee representative of Government departments, technical societies and trade and industrial bodies, and there are five sectional committees dealing with mechanical, electrical and civil engineering, chemical and fuel matters respectively. In any work undertaken, the initiative lies with the interests concerned, and after tentative standards have been prepared they are submitted to the associated institutions, and those chosen are circulated for comment and recommendation. It is claimed that in this way the final standards approved should meet local conditions and requirements and then the industry or trade concerned may, if it desires, adopt them in its daily policy and practice.

It is to be noted also that a comprehensive scheme of training and technical education is now in being. The adoption, in 1922, of the Apprenticeship Act, marked the beginning of a new era in industrial legislation, and since then, 15,000 lads have completed their apprenticeships in accordance with its provisions and under the supervision of the committees of employers and employees which assist in its administration. The Act is operative in twelve groups of industries, and the general practice is a five-year training of young people after completing the primary and, in some cases, part of the secondary school course. They are then indentured to individual employers and are required to enrol for part-time courses at the technical colleges, a portion of their attendance there being timed to take place during ordinary working hours. For those resident in places far removed from centres where technical colleges exist, the Government has arranged for correspondence courses under the ægis of the Witwatersrand Technical College and, where students show satisfactory diligence, employers are responsible for the class or correspondence fees. It will thus be seen that South Africa is making every endeavour to provide for the needs of her technical students in the most practical way, and it may be premised that these preparations will react most favourably upon future industrial developments.

* Industrial Development in South Africa and Facilities for the Establishment of Factories. Published by the Department of Commerce and Industries. Edited by Dr. Vernon Bosman. (Pretoria: Government Printer, 1936.) 1s.

# Science News a Century Ago

### The Reef at Pernambuco

FROM Ascension, H.M.S. *Beagle* sailed for Bahia in order to complete the chronometrical measurement of the world. Arriving there on August 1, 1836, she sailed for the Cape Verde Islands on August 6, but being delayed by unfavourable winds on August 12 put in at Pernambuco, anchoring inside the reef. Of this reef, Darwin wrote: "I doubt whether in the whole world any other natural structure has so artificial an appearance. It runs for a length of several miles in an absolutely straight line, parallel to, and not far distant from, the shore. It varies in width from thirty to sixty yards, and its surface is level and smooth; it is composed of obscurely stratified hard sandstone. At high water the waves break over it; at low water its summit is left dry, and it might then be mistaken for a break-water erected by Cyclopean workmen. . . . Although night and day the waves of the open Atlantic, turbid with sediment, are driven against the steep outside edges of this wall of stone, yet the oldest pilots knew of no tradition of any change in its appearance. This durability is much the most curious fact in its history; it is due to a tough layer, a few inches thick, of calcareous matter, wholly formed by the successive growth and death of the small shells of Serpulæ, together with some few barnacles and nulliporæ. These nulliporæ, which are hard, very simply-organised sea-plants, play an analogous and important part in protecting the upper surfaces of coral-reefs, behind and within the breakers, where the true corals, during the outward growth of the mass, become killed by exposure to the sun and air. These insignificant organic beings, especially the Serpulæ, have done good service to the people of Pernambuco; for without their protective aid the bar of sandstone would inevitably have been long ago worn away, and without the bar, there would have been no harbour". Darwin in 1841 described the bar in detail in the *London and Edinburgh Philosophical Magazine*.

### Monument to Champollion

ON August 13, 1836, the *Athenæum* said: "The monument erected at Figeac to the memory of Champollion, is an Egyptian obelisk of the purest and severest style, of very hard granite from a quarry near Figeac. It bears an inscription to the following effect: 'To the memory of F. J. T. Champollion, who first penetrated into the mysteries contained in the writing and monuments of ancient Egypt, and who was taken from Science by a premature death on the 4th of March 1832. He was born at Figeac the 23rd of September 1791'." Champollion died in Paris, and was buried in the Père-Lachaise cemetery. His grave is marked by an obelisk bearing a medallion.

### Aerial Surveying from Balloons

IN the *Mechanics' Magazine* of August 13, 1836, is a note from the *Scotsman* referring to the work of Charles Green (1785–1870), the aeronaut who up to that time had made 218 ascents. On the last occasion when Lord Clanricarde went up with him, he observed, it was said, that surveyors and architects could with greater facility take plans of noblemen's estates by ascending in a balloon, as they could have a bird's-eye view of every locality, and if they only once adopted that method they would never relinquish it. Since the suggestion was made, an artist named Burton had called on Mr. Green to obtain the plan of a balloon constructed so as to be used for this purpose. The inventor proposed to fasten the car to the balloon by a swivel and to build a waggon to which the balloon could be attached. The waggon could be conveyed to any place a surveyor required, where, on a calm day, he could take plans, carrying with him the proper instruments.

### Sir Charles Bell leaves London

SIR CHARLES BELL, the eminent surgeon, having accepted the chair of surgery at Edinburgh left London in August, 1836. One of the last letters he wrote from his residence, 30 Brook Street, was to his sister Miss Bell. In this he said: "The house is in a hustle. Books gone—pictures packing. People surveying the house! This does look like a change. All my sacred corners usurped—a naked house not a home. . . . I leave no enemy behind me, and Marion is universally beloved. . . ."

"While the season lasts, our society is all we could wish; but now our friends hurry to their better houses in the country, where they invite us, but where we cannot go. Many a long day we have been left solitary in a crowd, losing spirits and health."

"Without independent fortune, the relations which we have formed with society are not without their drawbacks. I must be independent and through exertion more than fortune. I must pursue that course through which I have attained station to feel comfortable. I could have made a fortune, and so my friends say, but I could not also attain to what I am, and to what they would have me. . . ."

### Statistical Desiderata

IN the Section of Statistics at the sixth meeting of the British Association held at Bristol in August 1836, Mr. W. R. Greg brought forward proofs of the total deficiency of statistical information in some subjects of international importance, and the unsatisfactory nature of that which had been collected by public authority in others. From examination of population tables, tables of births and deaths, criminal statistics, the statistics of education, of illegitimate birth and of stolen property, the author was led to conclude, that "with the exception of the revenue and commercial tables, no general documents yet exist in England from which any philosophical influences can be safely drawn, and that till the materials are wholly re-collected, all attempts to elicit such inferences can only end in disappointment and error". In order to obtain more satisfactory results in future, he deems it highly necessary to depart from the plan so commonly resorted to, of issuing circular queries, and to commit the task of obtaining authentic and complete information to individuals who shall make the execution of it their professional duty and whose labours shall be remunerated accordingly.

### County Natural History Societies

IN a paper entitled "A Proposal to Establish County Natural History Societies for Ascertaining the Circumstances in all Localities which are

Productive of Diseases or Conducive to Health", Dr. J. Conolly, late professor of the practice of medicine in the University of London, after pointing out the advantages which the country practitioner possessed over those living in towns, especially as regards the intimate acquaintance he gradually acquired concerning every circumstance in the locality, suggested the formation in every county in England of a society consisting of scientific men of every class and description and comprising the following sections: (*a*) statistics, (*b*) geology and mineralogy, (*c*) geography, (*d*) meteorology, (*e*) agriculture, (*f*) botany, (*g*) archæology, (*h*) chemistry and (*i*) medical topography and statistics. The business of this last section would be "to apply all the exact knowledge furnished by the other sections to the subject of health and disease; to note, with extreme care, the relation of phenomena developed in the human body to the natural or statistical or historical and political and moral circumstances in which the subjects of such phenomena were placed". (*Trans. Prov. Med. and Surg. Assoc.*, 1, 180; 1836.)

## Societies and Academies

### Paris

Academy of Sciences, June 29 (*C.R.*, 202, 2109-2220).

JEAN TILHO: The present condition of the zone of capture of the Logone by the Bénoué. Further measurements and observations confirming the possible danger of the capture of the Logone (Tchad basin) by the Bénoué (Niger basin).

VITO VOLTERRA: The integration of the equations of biological fluctuations.

CLAUDE CHABAUTY: Certain ternary diophantic equations.

FARID BOULAD BEY: The general forms of equations of nomographic order 6 and 5 representable by conical nomograms.

S. BUCHEGUENNCE: The deformation of Bianchi surfaces.

GEORGES GIRAUD: A general class of equations with principal integrals.

ALEXANDRE GHIKA: The interpolation of analytical functions.

EMILE MERLIN: The nature of the trajectories of certain perfect heterogeneous fluids.

HENRI MINEUR: The galactic rotation of globular clusters.

JEAN JACQUES TRILLAT and MLLE. RENÉE VAILLÉ: A method of measuring the adsorption of oils by metallic surfaces.

PIERRE CIBIÉ: A method of laboratory control of the light projectors of motor-cars.

A. HAUTOT: The $K$-radiation of crystallized boron. It is concluded that the remarkable variation of the electrical conductivity of boron with temperature is due to a variation of the energy distribution of the conductivity electrons.

JACQUES ERRERA POL MOLLET and MARY L. SHERRILL: The infra-red absorptions of liquid hydrocarbons. The influence of the double linkage.

HENRI BIZETTE and BELLING TSAÏ: The thermal variation of the magnetic double refraction of nitric oxide (NO) and of compressed oxygen.

MLLE. MADELEINE GEX: Variations in the ultra-violet spectrum of phenol as a function of the $p$H. Over a range of $p$H from 1 to 12, the changes in the ultra-violet spectrum suggest four changes in the structure of the phenol molecule.

F. HAMMEL: The analogy of the monohydrated sulphates of the magnesium series. Results of X-ray studies of the monohydrated sulphates of magnesium, manganese, iron, cobalt, nickel, copper and zinc.

FRANÇOIS BOURION and MLLE. ODILE HUN: The cryoscopic determination of the total hydration of the ions of hydrochloric acid.

MLLE. CÉCILE STORA: The mechanism of the Becquerel effect of organic molecules.

TR. NÉGRESCO and W. J. CROOK: The equilibrium relations of the oxides of iron in the slag of refinery furnaces.

MLLE. JEANNE BOULANGER: The systems zirconyl oxalate, alkaline oxalates and water.

PIERRE CARRÉ and LOUIS PEIGNÉ: The relative mobilities of the normal alkyl radicals in their chlorothioformates.

HENRI WAHL: The chlorination of $p$-chlortoluene. The chlorination of $p$-chlortoluene gives a mixture containing 58 per cent of the 2,4.dichlortoluene and 42 per cent of the 3,4.compound. This proportion is not affected by the nature of the catalyst, or by variations of temperature between 20° and 40° C.

PIERRE LEGOUX: The origin of the gold of the Guinea-Sudan borders.

LOUIS DONCIEUX, LOUIS DUBERTRET and HENRI VAUTRIN: The Oligocene and Burdigalian of the Syrian desert.

MAURICE PARAT: The Oxfordian and Kimmeridgean of Milne Land (Eastern Greenland).

ANDRÉ AURIC: The suitability of a cycle of 334 years for meteorological predictions.

HENRI COLIN and MARCEL SIMON: The proportion of ash and its alkalinity in the beetroot.

ÉTIENNE FOEX and MAURICE LANSADE: A bacteriosis of the banana tree.

M. and MME. FERNAND MOREAU: The toxicity of some cations for the Saprolegnieæ.

LÉO ESPIL and GABRIEL MANDILLON: The action of bromacetates on various alkaloids. Sodium bromacetate reacts with strychnine sulphate, giving a non-toxic product. The toxicity of this alkaloid would appear to be connected with the existence of a free amino group.

MME. VÉRA DANTCHAKOFF: Sex hormones and the role of the placenta in the ontogenesis of mammals.

ISRAEL and MICHEL MAGAT: The ultra-violet spectrum of normal and leucæmic blood.

FRED VLÈS: The conditions of stimulation of fluorescence of proteins.

ERNEST KAHANE and MLLE. JEANNE LÉVY: The origin of the choline of sperm. The existence in sperm of free choline is a secondary phenomenon due to the action of a diastase on a precursor of choline.

ALI MUSTAPHA: The action of the cholera vibrion on milk and cholerigen power.

GEORGES BLANC and MARCEL BALTAZARD: The influence of privation on the development of the virus of murin typhus in the flea (*Xenopsylla Cheopsis*)

ALEXANDRE BESREDKA and MICHEL BARDACH: The intra-cutaneous immunization of rabbits against epithelioma inoculated in the eye. Intra-cutaneous epithelioma, a benign tumour, acts as a true vaccine against epithelioma of the eye, a malignant tumour.

## Amsterdam

Royal Academy (*Proc.*, 39, No. 6, June 1936).

W. H. KEESOM and G. SCHMIDT : Researches on heat conduction by rarified gases. (1) The thermal accommodation coefficient of helium, hydrogen, neon and nitrogen on glass at 0° C.

J. BOESEKEN : The oxidation products of thiourea. The dioxide as derivative of sulphoxylic acid ($H_2SO_2$).

E. D. WIERSMA : Physical resemblance in connexion with mental similarity (1). Researches on the inheritance of temperament and resemblance of offspring and parents.

K. MAHLER : An analogue to a theorem of Schneider (2).

H. FREUDENTHAL : (1) A class of rings in Hilbertian space. (2) The abstraction of the concept of an integral.

W. BLEEKER : Meteorological data from the three Dutch expeditions to the Karakorum (1). Observations of pressure, temperature, humidity, etc., at various stations in the Karakorum range.

T. WEEVERS : A consideration of some phytochemical problems. The phytochemical characteristic of a species, genus or family of plants is not a single compound, but a particular combination of several compounds.

T. E. DE JONGE-COHEN : Radix præmolarica unilateralis.

N. SUZUKI : The diencephalic and some other systems in *Xantharpyia amplexicaudata* (1).

B. VAN DER EYKEN : Dentition and teeth development in the irisforelle (*Salmo irideus*) (6). Teeth development.

A. CHARLOTTE RUYS : The isolation of typhoid bacilli from water. Wilson and Blair's medium readily permits of the isolation of the typhoid bacilli from infected water.

D. VAN DANTZIG : Ricci calculus and functional analysis.

## Geneva

Society of Physics and Natural History, May 7.

KURT H. MEYER and W. LOTMAR : Note on the elementary lattice of crystallized caoutchouc. From a study of the interferences, the dimensions of the elementary lattice of crystallized caoutchouc can be calculated. It is monoclinic ($a = 8 \cdot 54$ A.; $b = 8 \cdot 20$ A.; $c = 12 \cdot 65$ A.; $\beta = 83°$). The arrangement of the atoms in this lattice, which includes eight isoprene radicals, can be established. Thus, caoutchouc should be classed in the $C^{5}_{2h}$ spatial group.

A. WEINSTEIN : The equations of vibration of a plate. Calculation of close upper and lower limits for the frequency of the overtone of a square clamped plate.

ERNEST C. G. STUECKELBERG : Continuous $\gamma$-radioactivity and unitary field theory. The Fermi explanation of continuous $\beta+$ radioactivity allows for a recombination between the created positive electron and an orbital electron. The annihilation radiation can escape from the atomic system even if there is not enough energy available to produce a positive electron. Thus there is a pure and continuous $\gamma$-ray emission. Considering electron, neutrino, proton and neutron as different quantum states of one elementary particle, only four different transitions are possible if conservation of charge and Dirac's equation are postulated. They explain the Fermi formula of $\beta$-decay and the nuclear exchange forces of Heisenberg and Majorana. If a neutrino theory of light is developed, the electric field and the material field (particles) can be described by the 16 components of a unitary spinor field (see also NATURE, June 20, p. 1032, and June 27, p. 1070).

B. SUSZ and S. FRIED : The Raman spectrum of gallic acid, of some of its derivatives and of tannin. The authors give the Raman spectrum of gallic acid, of methyl gallate, methyl trimethylgallate, triacetylgallic acid and Chinese gallotannin with some interpretations of the frequencies found.

## Moscow

Academy of Sciences (*C.R.*, 1, No. 7, 1936).

S. SOBOLEV : Evaluations concerning the families of functions having derivatives with integrable squares.

L. KANTOROVICH : The general theory of operations in semi-ordinated spaces.

A. I. ALICHANIAN, A. I. ALICHANOV and L. A. ARZIMOVICH : The law of the retention of impulses at the annihilation of positrons.

V. ARKADIEV and A. MOROSOVA : Photographic representation of a Hertzian dipole.

N. SELJAKOV : To what class of symmetry does ordinary ice belong ? There are two modifications of ice ; $\alpha$-ice is hexagonal and $\beta$-ice is rhombohedral.

M. ELIASHEVICH : The rotation-vibration wave equation for a polyatomic molecule.

D. RAUZER-CHERNOUSOVA : The Fusulinidae and the stratigraphic subdivision of the oil-bearing limestones in the Sterlitamak district.

J. M. URANOVSKIJ : The rôle of the nervous system in the regeneration of the extremities in axolotl.

## Sydney

Royal Society of New South Wales, June 3.

A. H. VOISEY : The Upper Palæozoic rocks around Yessabah near Kempsey, N.S.W. The various rock types in an area of about thirty square miles are described, classified and mapped, these rocks being mainly of sedimentary origin. This work reveals a very interesting story of bygone ages. More than three hundred million years ago there existed a shallow sea abounding in life ; but many organisms were killed by showers of ash from violently explosive volcanoes. Later came uplift, and then another subsidence again ushered in marine conditions. The climate then was cold, and icebergs floated about on this sea fringed with active volcanoes. Further uplift and depression followed, with a gradual dying out of volcanic activity. After a final uplift, came extraordinary changes—pressure folded the rocks into great arches and troughs, and huge rock masses were displaced along cracks. Then for perhaps two hundred million years the land surface was gradually but effectively worn down, until it was but little above sea-level : uplift followed, and out of the highlands so formed the present Macleay River cut its valley.

GERMAINE A. JOPLIN : The Ben Bullen Plutonic Complex, N.S.W. The Ben Bullen complex consists of two intrusions of partial magma. The earlier mass is of noritic composition, and has differentiated *in situ*. The later intrusion is a quartz-mica-diorite, and this has reacted with the solid norites and given rise

to a series of cognate hybrids. Five chemical analyses show that the complex is closely related to the Hartley series, and possibly represents a northerly extension of the Hartley-Bathurst bathylith.

H. G. RAGGATT: Geology of the north-west basin of Western Australia, with particular reference to the stratigraphy of the Permo-Carboniferous. The stratigraphy and lithology of the Permo-Carboniferous system in the north-west basin of Western Australia are described in detail, and a subdivision into series and stages suggested. Correlation of these rocks with the Permo-Carboniferous of the Irwin River is discussed. An outline of the stratigraphy of the Cretaceous and the geological history and structure of the region are given.

WINIFRED MANKIN: An attempt at quantitative analysis of silver-gold alloys. Arc spectra were obtained from alloys of silver and gold in various proportions in the attempt to find a definite relation between the ratio of the intensities of corresponding lines in the spectra of the two metals and their proportions in the alloy. The alloy formed a bead in the crater of a carbon arc. Three pairs of corresponding lines were examined. No regular relations were obtained, and this is due mainly to the relative rates of volatilization varying considerably with slight changes in the arc conditions. Chemical analysis showed that the relative proportions of the metals were changed considerably, and in an erratic manner, by the passage of the arc. Suggestions are made for modifications of method.

H. FINNEMORE and JOYCE M. COOPER: Cyanogenetic glucosides in Australian plants (4). *Zieria lævigata*. The leaves of this rutaceous plant yield by the action of its own enzyme 0·2 per cent of hydrocyanic acid, and approximately twice this amount with additional enzyme. It is shown that this is due to the decomposition of zierin, the glucoside of metahydroxybenzaldehyde cyanhydrin.

## Official Publications Received

### Great Britain and Ireland

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 2: Pneumatic Equipment for Horse Drawn Vehicles. By Alexander Hay. Pp. 20. (London: Rubber Growers' Association.) [137

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# Science and Armaments

NOTHING could demonstrate more completely what the Prime Minister recently termed the madness of re-armament than the fact that in the recent debate on defence in the House of Commons, Government spokesmen failed to reply to the two questions which are uppermost in everyone's mind: What is the limit of the expenditure involved, and against whom is the programme directed? The questions indeed cannot be answered. There is no limit; and to express one's fears in definite words might well be to start the conflagration universally dreaded. Unless intelligence once again takes control over passion and prejudice in the relations of nations, and force is relegated to its proper function of maintaining law and order, there can be no escape from a conflict which would involve ruin for all. Nor can we hope for peace among nations any more than among individuals if we encourage the view that wrongs cannot or will not be dealt with by reason or persuasion and can only be redressed by force.

Even the staunchest supporter of the present programme of re-armament and defence in Great Britain can scarcely avoid misgivings as to its eventual outcome. Unless at the same time we can ensure that some real attempt is made to eliminate the root causes of international friction and misunderstandings, to control the mischief wrought by economic nationalism, and to secure a settlement of difficult economic and racial questions on a basis of social justice and not of *force majeure*, the attempts to strengthen armaments, however sincerely aimed at national defence, can only bring conflict nearer. Collective security is in fact the only possible form of security to-day. All else is merely a matter of relative insecurity and how soon the crash will be.

The most serious feature of the recent debate was, however, the absence of reference to the imperfection of defence against modern methods of warfare. Responsible technical and scientific opinion is at one in agreeing that any protective measures for the general population against air attack by chemical means is at best imperfect and inadequate, and scientific workers cannot evade their responsibility for warning the population of the limitations of the measures now being considered by the Air Raid Precautions Department of the Home Office. There could be no greater calamity than for the population to be deluded into believing itself to be largely immune from the consequences of such attacks in the event of an outbreak of war. The proposals to transfer part of Woolwich Arsenal to western and northern districts of the country, and to duplicate the coal oil plant at Billingham in South Wales instead of on the same spot, indicate in themselves that the effective defence even of munition centres is problematic.

To this extent, therefore, scientific workers will be in general sympathy with a resolution which was submitted at the meeting of the British Medical Association at Oxford in July. The resolution, however, proceeded further, and recommended the Association to take the initiative with the object of securing the co-operation of the medical profession of all countries to prohibit the manufacture of poison gas. Scientific workers would undoubtedly join in condemning the use of poison gas in conjunction with other forms of warfare as inhuman and degrading to civilization, even though they may doubt whether it is worth while to endorse too hastily proposals to discriminate against one particular kind of warfare.

The impossibility of effective defence measures against chemical warfare for the civil population should not blind us to the difficulty of securing its prohibition if resort was once made to warfare. Events in Abyssinia have demonstrated afresh the impossibility of relying on the pledges to a particular form of warfare when once a nation has broken its general pledge, even under conditions when provocation or retaliation in kind are impossible. Despite this impracticability, which was emphasized by speakers in the discussion at the British Medical Association, an amended resolution was passed which, condemning gas warfare, called on the Council to do everything in its power to secure the co-operation of the medical profession in all countries to prohibit the use of poison gas.

Apart from the serious doubts entertained by authorities as to the practicability of chemical warfare being prohibited, it is even open to doubt whether the restriction of particular methods of warfare is desirable. The very ruthlessness with which war is prosecuted with modern weapons, and the cynical disregard of international obligations or of any standard of humanity or chivalry in the conduct of a campaign, may even prove a gain to mankind in the end if the lesson is learnt that the real problem is that of eliminating and not merely of mitigating warfare. As Sir Henry Thuillier, who during the Great War was Controller of Chemical Warfare, has suggested, the interests of humanity might be better served if the whole populace appreciated in advance that the direct effects of resort to warfare would not be confined to the combatant services.

The lecture to which we refer has now been published in the *Journal of the Royal United Services Institution* for May last, and it will well repay study by all those who are really concerned with constructive efforts to establish peace and co-operation, and to secure the surrender or abatement of these national claims or rights which most hinder the working of a system of collective security and constitute the gravest danger to peace. Sir Henry Thuillier does much to stimulate clear thinking on questions where side issues have so long diverted attention which should have been given to the major question of eliminating the use of war altogether.

Proposals to restrict methods of warfare have arisen from economic considerations, as in regard to the battleship, but much more commonly on humanitarian grounds. In regard to the latter, a clear answer has rarely been given to the fundamental questions: Will the proposed restrictions actually reduce the inhumanity of war, and will the agreement be effective? The voluminous discussions which have taken place on chemical warfare, the submarine, the use of tanks, have not led to any general agreement on the answers which should be given. On the contrary, there is abundant evidence of the muddled thinking which Sir Henry Thuillier warns us is a most serious danger to peace and security.

Certain questions have to be frankly faced in any discussion on restrictions if clear thinking is to be ensured. Since all war is indescribably inhumane, is it to the benefit of the human race to try to reduce its inhumanity in two or three minor directions only? Nothing can really lessen its horrors, and it may well be better that the peoples should realize this in order that they may make every effort to put an end to it altogether. If it were known in advance that the effects of warfare would fall as ruthlessly on all classes of civilians, whether on the statesmen who had bungled diplomacy, or financiers or manufacturers or others whose desire for trade expansion or profits had contributed to its outbreak, as on members of the fighting services, much more serious and constructive efforts to prevent it might be made. On the question whether the proposed restrictions could really reduce the inhumanity at all, not only is there need for a close sifting of opinion but also for a frank facing of facts. The desire to abolish submarines or poison gas is largely based on lack of knowledge, false sentimentality, conservatism, fear of unknown methods and perhaps especially the fear that our adversary may prove more efficient in these new methods than ourselves. To the third question, whether we could have a reasonable guarantee that agreements of this sort would not be evaded, or even openly repudiated under stress of defeat, events in Abyssinia suggest a very definite and depressing answer. The only hope seems to be to organize a society in which constructive effort will be used to eliminate war altogether and to make civilized peoples realize the horrors and inhumanity of any such conflict between nations.

It is well that scientific workers should, as was done in the recent discussion at the meeting of the British Medical Association, dissociate themselves from the prostitution of scientific results in warfare or for other nefarious purposes: it is equally their duty, however, to do all in their power to ensure clear thinking on such matters. The

pertinent remarks of Sir Henry Thuillier about the alleged inhumanity of gas warfare, or even of the use of the submarine, should be welcomed by all scientific workers, and they reveal the essential childishness of much of the discussion on this point.

All war is inhumane ; and to fritter away effort discussing the relative inhumanity of different kinds of warfare is rapidly becoming intolerable. What has to be recognized is that war is not only inhumane but also under modern conditions its renunciation as an instrument of national policy, and as a means of dealing with international disputes, is absolutely essential if civilization is to survive. The question really is whether there is yet time to carry out the constructive work involved both in developing adequate machinery for settling international disputes, and for removing the causes of international friction and misunderstanding, before the world is overwhelmed in another outbreak. Scientific workers owe it to themselves, no less than to their science and to their civic responsibilities, to strain every effort to ensure constructive thinking in these matters and to promote the formulation and execution of policies adequate to secure that the enormous powers now at our disposal are used for the advantage of mankind instead of its destruction.

# A Sketch of World History

World History:
the Growth of Western Civilization. By R. Flenley and W. N. Weech. Pp. xix+757. (London: J. M. Dent and Sons, Ltd., 1936.) 12*s*. 6*d*. net.

WORKS on general history have often been noticed in NATURE, especially from the point of view of the space and the position which they assign to science. There has undoubtedly been a marked improvement in the matter, and the very attractive book under notice is a good example, suggesting also one or two points of criticism in its presentation. It is certainly the best thing of the sort that we have seen in English—a sketch of world history in some seven hundred pages with abundant illustrations and excellent maps and diagrams and written throughout by both authors with full knowledge and an almost perfect impartiality.

The questions of how to present the vast mass of material, and for whom one is writing, are, in this kind of book, supremely difficult. In this one, the readers who will gain most from it are those who have a fairly good knowledge beforehand and are glad to have it revived in a well-ordered summary up to date. For students who are approaching the subject for the first time, the language, ideas and implications of the writers are probably too difficult. This is the case more especially with Mr. Flenley, who does the modern portion. One often feels that the essential points could be conveyed without such an array of long and abstract words and in shorter sentences. On the other hand, Mr. Flenley grapples valiantly with the problem of including all sides of history—music, art and literature as well as science—and his allowance for science is relatively generous. Yet even so, how can one excuse in such a survey the complete omission of the marvels discovered in the heavens and presented so clearly in the Astronomer Royal's recent "Worlds Without End"?

Mr. Weech, who is an old schoolmaster, has a crisper and simpler style. Some of his short sayings are admirable; for example, "It was the spoken word, not the written, that counted with the Greek and made him the teacher of the western world. . . . He was an excitable, quarrelsome, kind-hearted creature. He was continually fighting his neighbour in the next valley, but when he had finished, he did not, like other conquerors, mutilate, crucify or scalp his captives, nor did he convert them into gladiators." On the other hand, Mr. Weech is much less adequate in his account of ancient science. The wonderful discoveries which have recently been made of the mathematics of Babylonia, and the medicine of ancient Egypt, find no place. The institution of the calendar is naturally mentioned, but not its connexion with the heliacal rising of Sirius. More should have been given of the sort of matter which Prof. Gordon Childe has just put out in his "Man Makes Himself"—the origins of civilization—even if further cuts had to be made in the political sections. It is also doubtful in the later portion whether the Impressionist and Post-Impressionist painters deserve the several pages which they get.

There is room, however, for wide difference of opinion as to such relative values, and the book is strongly to be commended in the sense mentioned above. The sober hopefulness of the "Conclusion" —after a summary of the successes and failures of the League of Nations—hits the mark very well.

F. S. MARVIN.

# Classical Dynamics

**Theoretical Mechanics:**
Dynamics of Rigid Bodies. By Prof. William Duncan MacMillan. Pp. xiii + 478. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36*s*.

WITH the publication of this volume on rigid dynamics, Prof. MacMillan has completed a task of first-rate importance. This work, together with its companion volumes on statics and particle dynamics and on the theory of the potential, constitute a trilogy which, for a long time to come, will be welcomed by successive generations of honours students of physics and of engineering. Despite the fact that the centre of interest has in some measure shifted from such studies, there was a real lack of a treatise which should serve the needs of this generation as Routh served those of an elder line of students. Routh's works, and Thomson and Tait, have become classics, and as is the fate of most classics are rather read about than read. No more brilliant introductions to the advanced study of mechanics are to be found than those of Horace Lamb. It is rare indeed to find a first-rate intellect which combines an almost unexampled power of exposition with a sympathetic appreciation of the needs of the average-student and a capacity for keeping mathematics in touch with physical reality. Lamb had these gifts in full measure, and his treatises on mechanics are an invaluable expression of these gifts.

But a work was needed which should carry the story farther and should view the subject from a rather different angle, and Prof. MacMillan's book fulfils this want. His treatment is severely classical; "the three laws of motion as given by Newton furnish the foundation for the entire structure"; and the section 'E' of the author index contains but the names of Eisenhart and of Euler. Both the geometrical and the purely analytical methods of attack are developed, and the author's preliminary account of the algebra of vectors is a model of clarity and of compression.

A chapter on moments of inertia follows, and here, perhaps, a digression on a point of very elementary, and yet of very general interest, may be permitted. The author defines the moment of inertia of a system of particles *with respect to a plane, line or point* as the "sum of the products of the mass of the particle into the square of the perpendicular distance of the particle from the plane, line, or point (or merely the square of the distance in the case of a point)". In doing so he has followed the example of Routh and of other classics. But many authors and teachers seem to be obsessed by the notion that the term *moment of inertia* has no meaning apart from an *axis*. Hence they lose the chance of developing that most instructive method of calculating the moment of inertia of a sphere about a diameter, which consists in calculating it *about the centre* by the simplest of all integrations—that of $4\pi r^2\rho.dr.r^2$ through the volume of the sphere, hence leading to $\frac{3}{5}Ma^2$ as the required value. The moment of inertia ($I$) about a diameter follows at once from the consideration that $I_x$ is equal to $\Sigma m(y^2 + z^2)$ with two similar (and equal) expressions for $I_y$ and $I_z$. Hence, by addition, we arrive at the value $\frac{2}{5}Ma^2$ with no more equipment than is required for the integration of $x^n.dx$ and for a knowledge of the geometry of a common brick. This simple method is obviously the one to be followed in elementary teaching. Which of the heroes who lived before Agamemnon invented it, the reviewer knows not, and would like to know; Binet (*teste* Routh) introduced the notion of moment of inertia with respect to a *plane* so far back as 1813.

The chapter on moments of inertia is followed by a series of chapters which deal with systems of free particles, general theorems on the motion of a rigid body, motion parallel to a fixed plane, the motion of a rigid body in space, integrable cases of motion about a fixed point, rolling motion and impulsive forces. This portion of the volume extends to some three hundred pages.

The hundred and seventy pages that remain are devoted to three important chapters, the first of which deals with Lagrangian equations, their application to holonomic systems and their extension to non-holonomic systems. The chapter closes with a brief account of Appell's equations, which are applicable equally to holonomic or to non-holonomic systems.

The penultimate chapter deals with the canonical equations of Hamilton, and the work closes with a discussion of the method of periodic solutions. Here, as in the more elementary parts of the book, the author extends a helping hand to the student by giving him a very clear résumé of the amount of matrix theory necessary for the comprehension of the argument. This chapter, one of the most interesting in the volume, deals with a method of attack which is both long and difficult, but which, as was remarked by its originator,

H. Poincaré, "is the only worth-while method that is known for a wide class of problems".

The book is by no means an easy one to read, but the difficulties which the reader will encounter are inherent in the subject. The author has the teacher's instincts, and has made the going as smooth as may be. Further, he has provided a large number of illustrative examples, of all degrees of difficulty, on which the student may try his hand.

If a word of general criticism be permitted, it is that the book would be considerably improved if its subject matter were more fully illustrated by examples taken from physical and engineering practice. True, the billiard ball, the top and the pendulum play a large part in the illustrations in the text, but the practical side of pendulum work is drawn from Routh, and in this, as in many other instances, examples are better studied in the light of modern practical work of precision.

The book fills a gap in the literature and may be heartily commended. A. F.

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# Mineral Resources of the French Colonies

**Les ressources minérales de la France d'outremer**

Publications du Bureau d'Études géologiques et Minières coloniales. 3: Le zinc, le plomb, l'argent, le cuivre, l'or, les minerais radioactifs, le mica, les pierres précieuses, substances diverses. Pp. ii+394+5 plates. 40 francs. 4: Le phosphate. Pp. ii+207+3 plates. 20 francs. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1935.)

THE issue of these two volumes on French colonial mineral resources by the Bureau d'Études Géologique et Minières Coloniales will be welcomed by readers who have already made themselves acquainted with vol. 1 on coal and vol. 2 on iron ore.

Vol. 3 covers a number of important metals and minerals, including zinc, lead and silver by F. Blondel, copper by P. Lion, gold by P. Delaître, radioactive minerals by H. Buttgenbach, mica by P. Chomette, precious stones by A. Lacroix, and various other metals and minerals, namely, aluminium, asbestos, antimony, arsenic, barytes, diatomite, mercury, nitrate, platinum, pyrite, rocksalt, potash and mineral waters, by F. Blondel.

As the lead–zinc ore deposits of French North Africa may be regarded as forming a Mediterranean circuit with those of Spain and Italy, M. Blondel includes all three in a useful account of the lead–zinc ore deposits of the western Mediterranean generally. On the whole, this region is one of much importance from the point of view of the supply of these base metals. M. Blondel concludes this section by a statistical account in which he examines the national position in France as regards supplies of lead and zinc.

The importance of copper in modern industry, the large necessary imports and very small production in France, makes M. Lion's account of the French position as regards copper one of much interest. Of considerable interest also is his description of the geology of the copper deposits of the Niara basin to the west of Brazzaville in French Equatorial Africa, and his account of the economics of copper from the historical point of view as well as with regard to the present position.

In the section on gold, M. Delaître gives an account of the geology and distribution of gold in the French colonies, and explains the simpler methods of exploitation applicable by prospectors in opening up superficial deposits in newly-discovered gold areas. In a brief section on radioactive minerals, M. Buttgenbach mentions deposits other than those of the French colonies, and gives a very useful description of the important deposit of uraninite (pitchblende) and its alteration products at Chinkolobwe in the Belgian Congo. In the section on mica, M. Chomette deals with mica generally, but briefly, and refers particularly to Madagascar deposits of muscovite and phlogopite, of which the latter are the more important. Madagascar produces phlogopite of superior quality and appears to have large reserves.

The section on French colonial occurrences of gemstones by M. Lacroix makes an attractive feature, chiefly on account of the remarkable assortment of beryl, tourmaline and other minerals of gem quality in Madagascar pegmatites, which are especially interesting from the mineralogical and petrological points of view. It is interesting to read in this section of the doubts that were entertained up to about a century ago as to whether diamonds really existed in Africa. Since then, Africa, especially South Africa, has produced nearly all the world's diamonds; but it is a very curious fact that, although important discoveries of exploitable diamond deposits have been made in recent years in the Belgian Congo, Angola,

South-West Africa Territory, Tanganyika, Gold Coast and Sierra Leone, no find of any importance has hitherto been recorded in French Africa. No diamonds have been found in Madagascar, and the occurrences in French Equatorial Africa are as yet of no economic importance.

In the closing section of vol. 3, M. Blondel states that the auriferous stibnite mine at Lucette in Mayenne, France, became exhausted and was closed in 1934, a reminder to us, if one be needed, of the wasting nature of the earth's mineral assets.

In vol. 4, which is devoted entirely to phosphate, the important deposits of phosphate in Morocco are accounted for by A. Beaugé, who deals with their geology and explains the working of the organization of the Office Chérifien des Phosphates; and E. Lenhardt, who deals with methods of exploitation and transport.

A separate section is devoted to Algeria and Tunis by P. Reufflet, and another to the marketing of phosphates by H. de Bailliencourt-Courcol. In another section, A. Lacroix deals with phosphatized land-surface deposits such as those due to the replacement of limestones by the action of solutions arising from leached coverings of guano, and corresponding aluminium phosphates formed by the action of similar solutions on trachytes and other igneous rocks.

Not the least interesting section of this volume from a scientific point of view is the one given to a discussion of the origin of sedimentary phosphate beds of marine origin by L. Cayeux. These beds have been formed at intervals from the earliest geological times, and on account of their importance as a source of phosphate fertilizers may be regarded as among the front-rank mineral resources from the point of view of human welfare. The problem of their origin is a puzzling one. M. Cayeux has long held the view that the formation of marine phosphate beds could only take place after a disturbance of the equilibrium of the sea floor. To this *sine qua non* of sea-floor disturbance, he now adds bacterial action as essential. In some way or other, which is not clear, the bacteria are roused from a state of dormancy to one of action by the disturbance of the sea floor, and set about elaborating phosphoric acid from the sea water, while phosphoric acid attacks any calcium carbonate that may be available, forming calcium phosphate. In this environment, he tells us, fish may flourish abundantly, and the accumulation of their remains is added to that of the phosphate deposited on the sea floor; but the extent to which they contribute is very variable. To the question "Are phosphate beds now forming on the sea-floor?" M. Cayeux replies very emphatically in the negative, and claims that the conditions essential for their formation do not exist at the present day.

Both volumes are well illustrated and indexed, are provided with useful bibliographies, and are likely to be serviceable for many years as works of reference on French colonial resources of the minerals with which they deal.

# Formulæ of Medieval Painters

**The Materials of Medieval Painting**
By Daniel V. Thompson. Pp. 239. (London: George Allen and Unwin, Ltd., 1936.) 7*s.* 6*d.* net.

MR. DANIEL THOMPSON has been engaged for many years in the study of the large number of medieval MSS. containing recipes for carriers, grounds, pigments and mediums which are to be found in the libraries, both in Great Britain and elsewhere in Europe. The actual number of MSS. examined amounts to 157, and in this simply written book we have the outcome of a laborious research, involving problems in translation, and the testing out of many recipes in the laboratory and the studio.

Mr. Thompson has already given us the most perfect text of Cennino Cennini's book on painting and an excellent translation, a book on tempera painting which was the result of many years practice based on Cennino Cennini, and many other contributions to the literature of the subject, and this is his latest contribution. Those who wish to look further into the subject will find in *Speculum* of October, 1935, references to actual MSS. and recipes.

A German scholar would have doubtless written many fat volumes on the material collected by Mr. Thompson, and it is to be hoped that he will still undertake this work. In the meantime, this book, based on a course of lectures given in the Courtauld Institute, enables the connoisseur, artist and collector to obtain the distilled essence of his researches in an easily read and simple form. The classical work on the subject is "The Ancient Practice of Painting" by Mrs. Merrifield, and since then excellent editions of special MSS. have been made. Ernest Berger published certain MSS. in his learned volumes on the history of painting,

and we have from Wilhelm Theobald an excellent edition of Theophilus, and there are others.

Valuable as these publications are, they have two defects. Many valuable recipes may be missed, and too much importance may be given to a single recipe. By making a critical examination and comparison of a large number of MSS. which have so far been neglected, not only are new recipes discovered, but so wide a survey also results in a more trustworthy judgment of what was the actual practice.

It is perhaps unnecessary to say that a book like this starts as many questions as it answers. The paragraphs dealing with verdigris alone, for the preparation of which many recipes exist, call for an investigation into organic basic salts of copper and their properties as pigments. The absence of recipes for certain pigments is also of interest. A copper resinate made by dissolving verdigris in a pine oleoresin was used so early as the close of the eighth century, yet no recipe has yet been found earlier than that given by Dr. Mayerne in the seventeenth century.

Very few recipes, and those of little value, are given for the preparation of madder lakes, yet fine madder lakes which have stood remarkably the test of time are found so early as the late fifteenth century, and it is difficult to decide how they can have been prepared. The use of madder as a dye was confined to certain dyers in Marseilles, and they may have possessed secrets which were unknown to the painter.

The publication of this book is singularly opportune, when we have at last in the Courtauld Institute a laboratory equipped for research on these lines. Mr. Thompson has provided for this work with a rich mine of material.

A. P. LAURIE.

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# Vasodilator Substances in Animal Tissues

**Gefässerweiternde Stoffe der Gewebe**
Von Prof. J. H. Gaddum. Eingeleitet von H. H. Dale. (Monographien zur Pharmakologie und experimentellen Therapie, herausgegeben von Philipp Ellinger.) Pp. xii + 200. (Leipzig: Georg Thieme, 1936.) 18 gold marks.

THE basic problem can be stated by pointing out that in the animal body there is a central mechanism for cutting off the blood supply to the different organs; but, so far as present knowledge goes, no central mechanism for increasing it. How then is an active organ, for example, a particular group of muscles in the leg, to obtain a greater blood supply than it received when resting? It was formerly believed that the liberation of acid as the result of tissue activity caused local vasodilatation; it is now thought that vasodilatation follows the liberation of various bases such as histamine, adenosine and others not yet identified.

The old and the new views are linked by the probability that the actual liberation of the bases is a secondary consequence of acid formation. Not, be it observed, that the problem has been recognized and attacked as a problem directly. A series of attempts have rather been made to isolate from tissue extracts substances responsible for various physiological properties possessed by these extracts. Just as biochemical progress has come from the identification of substances having a characteristic colour reaction, so by identifying substances having a characteristic vasodilator reaction, pharmacological progress has followed. This work is both difficult and laborious and demands much experience of the pitfalls of pharmacological analysis. Prof. Gaddum's book is an extremely valuable account of the chemical and pharmacological properties of the substances which have hitherto been investigated. A great part has been the work of Sir Henry Dale and his very able collaborators, and it is due to his persistence that the subject has been extended so as to throw light on many other aspects of physiology. A stimulating introduction comes from Sir Henry's pen.

The book deals in succession with histamine, acetylcholine, adenosine and then with substances of unknown composition. The author then strains the title by including a chapter on the chemical transmission of nervous impulses, but this will be perhaps its most useful feature to those not working in the special field. The book is a fitting testimonial to Prof. Gaddum. Nothing seems omitted, opinion is not withheld, and when given it is fully supported by evidence; the writing is modest and precise. The best tribute one can pay to the German translation by Dr. Feldberg is that it is very easy to read, but one may make the comment that it is strange to find in German the first general account of work so largely done in Great Britain.

J. H. B.

**A Text-Book of Inorganic Chemistry**
Edited by Dr. J. Newton Friend. (*Griffin's Scientific Text-Books.*) Vol. 11 : Organometallic Compounds. Part 3 : Derivatives of Phosphorus, Antimony and Bismuth. By Archibald Edwin Goddard. Pp. xxviii+318. (London : Charles Griffin and Co., Ltd., 1936.) 20*s*. net.

VOL. 11 of Dr. Friend's "Text-book of Inorganic Chemistry" deals with organometallic compounds, and the author is Dr. Goddard. It is divided into four parts, the first dealing with derivatives of elements of Groups I to IV of the Periodic Classification of the elements, and the second part with derivatives of arsenic. The present volume describes the organometallic derivatives of the other elements of Group V, namely, phosphorus, antimony and bismuth, leaving the elements of Groups VI–VIII for Part 4, now in preparation.

The book under review is planned on simple lines. Thus the first two chapters deal with fatty and aromatic derivatives of phosphorus, followed by a chapter on miscellaneous phosphorus compounds; fatty and aromatic compounds of antimony, and organometallic derivatives of bismuth are described in the remaining chapters of the book. Of these six chapters, the last two deal with groups of compounds which have formed the subject of original researches by the author.

The wide range of the subject is shown by the fact that reference is made to 2,600 derivatives of phosphorus, 700 of antimony, and 100 of bismuth. The most interesting chapter is perhaps the one which deals with the miscellaneous compounds of phosphorus, since, when this element is used in the form of chloride to bring about a simple replacement of OH by Cl or $>O$ by $Cl_2$, it often gives rise instead to addition compounds, which can then be hydrolyzed to phosphinic acids. In this and similar ways the chemistry of phosphorus is extended, until it almost begins to bear comparison with that of nitrogen, with which it is also associated as an essential element of plant and animal life.

This important group of organic compounds has been dealt with by Dr. Goddard in the same efficient manner in which Dr. Sidgwick described the organic derivatives of nitrogen, in a volume which has unfortunately been out of print for some years. By doing so, he has not merely contributed an additional volume to a well-known text-book, but also has earned the gratitude of his colleagues by giving (perhaps for the first time) an adequate account of an unfamiliar section of organic chemistry.

**The Medicine-Man of the American Indian and his Cultural Background**
By Prof. William Thomas Corlett. Pp. ix+369+14 plates. (Springfield, Ill., and Baltimore, Md. : Charles C. Thomas; London : Baillière, Tindall and Cox, 1935.) 22*s*. 6*d*.

AN unfortunate currency given to the popular term 'medicine man' to designate the shaman or priest-magician of the Amerindian tribes has given rise to much misunderstanding as to the true function of this important figure in the Indian social organism. Although the healing art comes within his province, his theory and practice are based on psychology and theology rather than on pathology and pharmacology. In fact, the cure of disease is not his primary function, but an incidental of his relation to the spirit world, in which he acts as the tribal specialist and go-between. Apart from the sweat-house, and a not very extensive acquaintance with simples, magic, which does not differ in essentials from the practices of other parts of the world, is the beginning and end of his diagnosis and treatment. The medicine man, like the shaman of the north-eastern tribes of Asia, to whom indeed he is closely related in many of his functions and attributes, is the spiritual guide of the tribe and its leader in emergency, in many instances holding a position analogous to that of the war chief.

Notwithstanding the basic identity of the conception of the medicine man's function throughout the North American tribes, there is no little variation in detail, both in the position they hold and in their methods of action. Dr. Corlett's purpose has been to place before his readers a conspectus of the evidence and to demonstrate the variations to be found in passing from one to any other of the areas of cultural differentiation into which the Indians of North America have been classified by anthropologists.

**The Phenomena of Polymerisation and Condensation:** a General Discussion held by the Faraday Society, September 1935. Pp. vi+412. (London and Edinburgh : Published for the Faraday Society by Gurney and Jackson, 1936.) 22*s*. 6*d*. net.

THIS publication records the first symposium in Great Britain specially convened to deal with fundamental aspects of polymers, among which synthetic resins and rubber are important industrial examples. The volume will naturally appeal to those workers on plastics who appreciate the importance of a knowledge of the principles underlying formation of their products.

The first section employs the weapons of X-ray spectrography, mechanical properties and kinetics of chain formation in elucidating structures, and is concerned with general concepts of polymeride formation. In general, the latter term is used in the modern sense to imply substances containing repeated units of definite structure not necessarily identical with the starting materials. An attempt by Dr. W. H. Carothers to connect, in a mathematical manner, polyfunctionality with polymer formation, and a study by Dr. K. Meyer of an inorganic polymer from phosphonitrilic chloride, deserve special mention.

The second section contains more specific cases, among which is a most suggestive contribution by Dr. H. Staudinger on the so-called 'insoluble polystyrene'. Although papers on phenol-aldehyde, amide-aldehyde and acetylene products are included, it is an unfortunate, but perhaps unavoidable necessity, that gives such prominence to polystyrene, at the expense of those more complex materials which have formed of late years the basis of industrial plastics development.

N. J. L. M.

**An Introduction to Contemporary German Philosophy**
By Dr. W. Brock. Pp. xx + 144. (Cambridge: At the University Press, 1935.) 6*s*. net.

THE study of German thought, which has been so popular in Great Britain, has been encouraged lately by the introduction of German philosophy as an optional subject in the syllabus of a first degree in German in the University of London. The interest taken by this University in German studies is further exemplified by its invitation to Dr. Brock to give a course of lectures on German contemporary thought. The book under notice is a direct result of this invitation.

German humanism and the development of the separate sciences are considered to be the background of contemporary German philosophy. Two new philosophical movements have asserted themselves since Hegel: the first covers the numerous attempts towards a philosophical synthesis of scientific results, and the second concerns epistemological inquiries. Then Nietzsche and Kierkegaard have cast their shadow over subsequent thinkers as well as over their contemporaries. These Dr. Brock considers in turn with an objective though sympathetic mind. But their conflicting conclusions leave still undecided the position of philosophy among the determining factors in human life. It would have been interesting to analyse the intellectual factors which have brought German thought to that peculiar position in which it has to renounce its very freedom of action and expression. T. G.

**Kursus der Kristallometrie**
Von Prof. Dr. Victor Goldschmidt. Aus dem Nachlass herausgegeben von Dr. Hans Himmel und Dr. Karl Müller. Pp. viii + 167. (Berlin: Gebrüder Borntraeger, 1934.) 10 gold marks.

THIS is essentially a practical guide to crystal measurement, drawing and calculation based on the established methods of the Victor Goldschmidt school of crystallography.

Following the general introduction, which deals with the various methods of projection, single-circle goniometry, illustrated mainly by the Penfield contact goniometer, is simply described and two examples are given. This section occupies six pages.

The remainder of the book is devoted to two-circle goniometry and is divided into two parts. Part 1, which provides an admirable introduction to the methods, deals with the two-circle contact goniometer designed by the author. The procedure involved in crystal measurement, drawing and calculation together with the preparation of crystal models is fully discussed and examples from each of the six systems are given in full. Part 2 illustrates the use of the two-circle reflection goniometer and provides examples of more advanced studies of simple and twinned crystals.

This posthumous work of the late Prof. V. Goldschmidt bears the characteristic marks of care and attention to detail which all his work illustrated, and is a very complete and lucid guide to the crystallographic methods evolved in great part by the author.

**Die Fermente und ihre Wirkungen**
Von Prof. Dr. Carl Oppenheimer. Supplement, Lief. 4 (Band 1, Specieller Teil: Haupt-Teil 9–12). Pp. 481–640. (Den Haag: W. Junk, 1936.) 28*s*.

THE fourth part of this work has appeared with commendable punctuality. It deals with the polyases, which are the enzymes which split the complex carbohydrates, the nucleases, the amidases and the first sections of the proteases.

Now that we possess at least an approximate knowledge of the structure of the more complex carbohydrates, it should be possible to make progress also in regard to the enzymes which attack them: for example, the increasing study of the polyfructoses, of which there are apparently several besides inulin, may teach something about inulase. The same applies to such enzymes as lichenase, chitinase, cytase and pectinase, and this section, which gives also a brief indication of the latest views in regard to the structural formulæ of these polysaccharides, will be found to be stimulating.

Recent work has more or less cleared up the structure of the nucleic acids: their appropriate enzymes either convert the acids into nucleotides or these latter into nucleosides and phosphoric acid, or effect the final degradation of the nucleosides into a base and a sugar: there is still much to learn about these and the way in which they work.

The amidases are those enzymes which break the bond between carbon and nitrogen as, for example, in adenine and guanine. They include arginase, of which a good deal is known, also those enzymes which hydrolyze acid amides and lastly urease.

The protein section is of an introductory character.

**Grundlagen der Quantenmechanik**
Von Dr. H. Dänzer. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 35.) Pp. xi + 163. (Dresden und Leipzig: Theodor Steinkopff, 1935.) 12 gold marks.

THIS brief but excellent introduction to quantum mechanics is likely to appeal much more to the mathematician than to the experimental physicist, for, as its title suggests, it deals rather with the fundamental ideas than with the applications of wave-mechanics to special problems. The treatment really assumes that the reader possesses a fairly good knowledge of mathematics, and the book should find a welcome from teachers of mathematical physics.

**La spectroscopie appliquée**
Par P. Swings. (Bibliothèque scientifique belge.) Pp. 188. (Paris: Hermann et Cie., 1935.) 15 francs.

ALL who are interested in the teaching or practice of spectroscopy will find this well-written and informative little volume of interest. In particular, the common errors which are encountered in connexion with spectroscope adjustments are discussed in some detail. The advantages and disadvantages of the various sources of light are also well considered, and it is clear that the author has made a profound study of the contemporary literature of the subject.

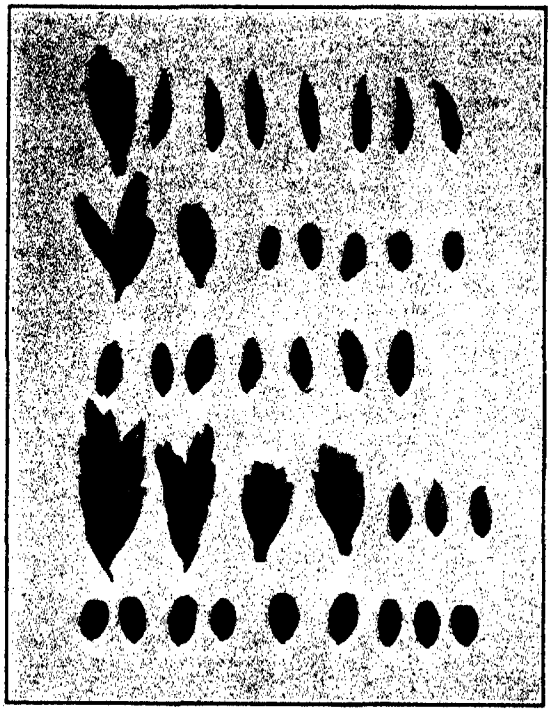
# Cereals of Ancient Egypt and Mesopotamia

By Prof. John Percival

THE origin of civilization is intimately connected with man's discovery of the cultivation of the cereal crops, the grain of which has formed the most important part of the diet of civilized people from the earliest times down to the present day.

It requires but little reflection to realize that the lives of the millions of inhabitants of the villages and towns throughout the world to-day are dependent upon the unceasing toil of the farmer; were he to discontinue his efforts, the congested humanity of our great centres of population could not exist very long. It is, indeed, no exaggeration to say that the total loss of the cultivated crops of one, or at most, two seasons all over the world, would wipe out the greater part of the human race, and leave the towns and all they contain silent and derelict; the farmer is truly worthy of more respect and sympathy than he usually gets.

Who were the first farmers, where did they live and what were the crops which they grew, are questions of fascinating interest on which light is being thrown by the patient researches of archæologists. Historic records of man's activities take us back some four or five thousand years, at which time village settlements and towns were already established in Egypt and parts of Mesopotamia. Samples of the kind of grain forming, as now, the chief portion of the diet of the people, have been unearthed, and it is to these that I now refer.



a

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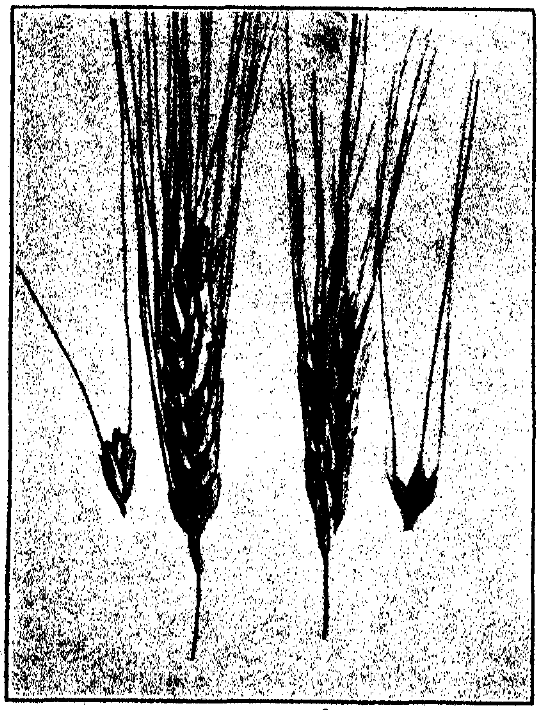
c

d

e

Fig. 2. *a*, Spikelet and grains of Abyssinian Emmer. *b*, Part of ear, spikelet and grains of Badarian Emmer, from Mostagedda (? 5000 B.C.) (Mr. Guy Brunton). *c*, Badarian grains of Emmer from Mostagedda. *d*, Portion of ears, spikelets and grain of pre-dynastic Emmer, from the Fayum desert. *e*, Naked wheat grains from pre-dynastic Fayum site (Miss Caton-Thompson) (all natural size).



a b

FIG. 1. *a*, Ear of modern Abyssinian Emmer, with spikelet. *b*, Ear of Bere barley, with triplet of single-grained spikelets (about half natural size).

From the earliest times in Egypt and in Mesopotamia, two kinds of cereal grains were cultivated, namely, wheat and barley. The wheat which was grown was a kind or race of this cereal known as Emmer (*Triticum dicoccum*). It was a very primitive kind of wheat, with flat ears having long awns or beards, like those of present-day barley (Fig. 1, *a*). Ears of Emmer when thrashed break up into short spikelets (Fig. 1), each of which contains two grains closely invested by the glumes or chaff, so much so that the naked grains for consumption can only be obtained free from the chaff by pounding the spikelets with a long pole

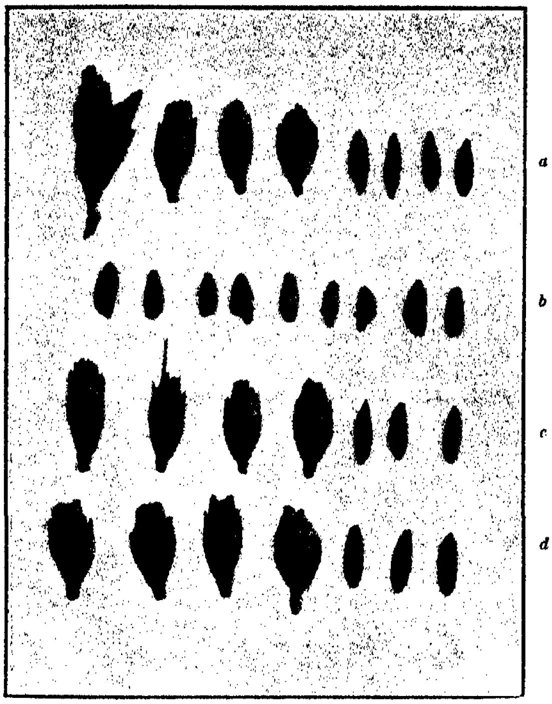



FIG. 3. *a*, Portion of ear, spikelets and grains of Emmer, from tomb of third dynasty, inside enclosure wall of step pyramid of Sakkara (about 3000 B.C.). *b*, Naked Emmer grains from underground gallery magazine, north side of Sakkara pyramid. *c*, Spikelets and grains of Emmer, from tomb of Tutankhamun (about 1400 B.C.). *d*, Spikelets and grains of Emmer from tomb of Eighteenth Dynasty (about 1500 B.C.) (all natural size).

in a kind of wooden mortar. The naked grains are narrow and pointed at each end, much narrower and less plump than the ordinary wheat of our fields to-day.

Emmer is still cultivated for human food in Abyssinia, parts of Russia and India, and in smaller amounts in north-west Persia, Serbia, south-west Germany and the Basque provinces of Spain. It is remarkable that many of the varieties of Emmer still grown are exactly similar in their specific characters to those cultivated by the most ancient Egyptians.

In addition to Emmer (*T. dicoccum*), several other different species of wheat are known with brittle ears which break up readily into short spikelets when thrashed; these are classed together as 'spelt' wheats, 'spelt' being in this case a generic term. Unfortunately, *one* of these has the specific name "Spelt" given to it, being called Spelt or Large Spelt (English), *Spelz* or *Dinkel* (German), *Epeautre* (French); its botanical name is *Triticum Spelta*. This wheat is a comparatively modern kind, quite unknown to the ancient people of Egypt, but Egyptologists in particular have frequently fallen into the error of translating the Egyptian term for Emmer by the word "spelt" and adding to it the name *Triticum Spelta* instead of *T. dicoccum*.

The ears of the other cereal, barley, are differently constructed from those of Emmer. In barley, three single-flowered spikelets grow close together on opposite sides of the axis of the ear; there are thus six longitudinal rows of spikelets. In the so-called two-rowed barley commonly grown in the fields of Great Britain, only the central flower of each triplet produces grain, giving rise to an ear with two opposite rows of grain. In Bere barley (*Hordeum vulgare*) and Six-rowed barley (*H. hexatichon*), all the flowers of the triplet of spikelets are fertile, and an ear with six rows of grain is produced.

All these kinds of barley are grown at the present time, the two latter being most frequently cultivated in Egypt and other countries bordering the Mediterranean. Both Bere and Six-rowed barley were cultivated in ancient Egypt and smaller amounts of the two-rowed form.

Whether the cultivation of Emmer preceded that of barley or vice versa has been the subject of controversy. A wild kind of Emmer grows in Syria, Palestine and regions near the Caucasus, and is generally accompanied by wild barley. Since there is no character in either which would suggest a preference for one of them, it would appear likely that both were selected contemporaneously by the first cultivators, probably

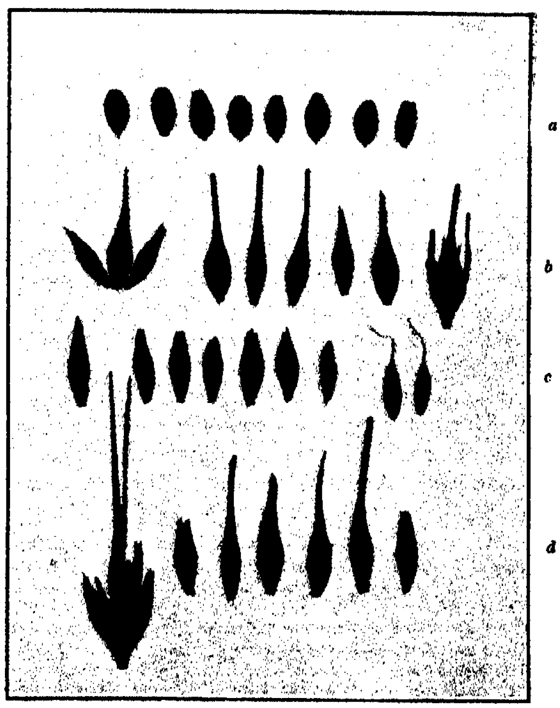



FIG. 4. *a*, Pre-Dynastic carbonized grains of barley, Fayum desert. *b*, Triplet of grains of Bere barley, single grains, and spikelet of two-rowed barley (?) Pre-Dynastic, from the Fayum desert. *c*, Grains of barley, and two 'seeds' of darnel (*Lolium temulentum*), from tomb of Third Dynasty, inside north enclosure of the step pyramid of Sakkara (about 3000 B.C.). *d*, Spikelets of barley of Eleventh Dynasty (Gebelion) (all natural size).

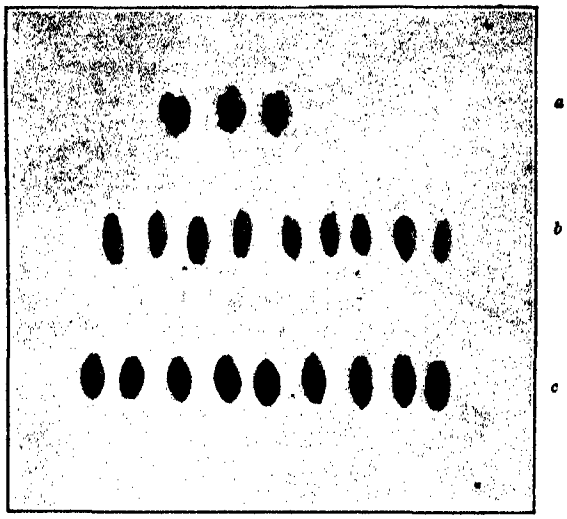



FIG. 5. *a*, Carbonized grains of three spikelets of Emmer, from grain room at Arpachiyah, near Nineveh (about 4000 B.C.). *b*, Carbonized grains of Emmer, and *c*, carbonized grains of barley from the same source (Mr. M. E. L. Mallowen, 1933) (all natural size).

thousands of years before the large-scale farmers of the Egyptian dynastic periods. This view is supported by the fact that mixtures of Emmer and barley, and separate samples of the two, have been found dating from the earliest times.

All these ancient grains, whether taken from underground pits, storehouses, tombs or vessels within the latter, are more or less carbonized. Naked grains generally exhibit complete carbonization, becoming changed into charcoal; their appearance suggests the action of fire, and they are often erroneously described as charred or burnt.

The change from the normal to carbonized grain is, however, a natural process which takes place at ordinary temperatures. The carbohydrates cellulose and starch, of which the cereal grains are largely composed, consist of carbon united with the elements of water; under certain obscure conditions, both become slowly dehydrated, leaving behind only the carbon.

The carbonization of complete spikelets is very much less marked than naked grains. The chaff is more resistant to dehydration, and usually appears dark brown in colour. The grains within such spikelets often show little change; the form of the grain, the hairs at its apex, are but slightly altered, and the starch grains in the endosperm retain their shape and reaction to iodine. The proteins of the endosperm are, however, completely decomposed, and the embryo is always disorganized and quite incapable of germination.

For more than a hundred years, samples of wheat and barley have been taken from tombs in Egypt, but only within comparatively recent times have trustworthy records been made of the archæological horizon from which the samples have been derived, and the age of many of the earlier finds cannot now be determined. During the last few years, however, much well-authenticated material has been submitted to me for examination, and it is with this that I deal here.

Among the most ancient specimens of cereal grains hitherto discovered in Egypt are those found by Mr. Guy Brunton at Badari (1923–34) and at Montagadda, Middle Egypt, in 1928. Fragments of ears and spikelets were obtained, together with carbonized grains of Emmer (*T. dicoccum*) and grains of Bere barley (*Hordeum vulgare*) (Figs. 2 and 4). The Badarian folk were growing both these cereals at a date antecedent to the predynastic period, which according to some Egyptologists extended from about 5000 B.C. down to 3400 B.C. when the first of the Egyptian dynasties was established. How much earlier than this these samples were harvested cannot be accurately assessed; some authorities have placed them as early as 10,000 or 15,000 B.C.

Another series of excellent samples belonging to the pre-dynastic period was obtained by Miss Caton-Thompson, in the Fayum desert, northwest of the Birket Qurun lake. A number of small straw-lined granaries or pits was discovered, in several of which were portions of typical ears of Emmer with grains (Fig. 2, *d*), as well as grains of Bere barley (Fig. 4, *b*). In some of the pits were found completely carbonized grains shorter and plumper than those of typical Emmer. Whether these are modified Emmer grains cannot be definitely settled, for the exact determination of the species of cereal grains when carbonized presents great difficulty, since the amount of

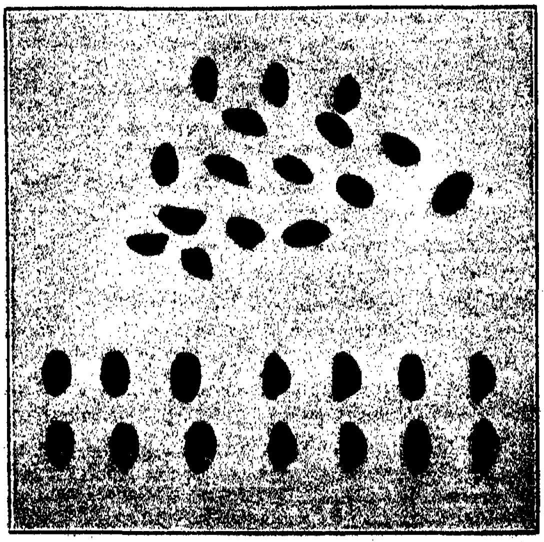


FIG. 6. Upper group: random sample of grains of wheat from a vase on the site of a Sumerian house at Jemdet Nasr, near Kish (3500 B.C.) (Prof. Langdon). First row of lower group: selected carbonized grains from the sample. Second row of lower group: grains of modern Rivet wheat (*Triticum turgidum*) (natural size).

change in the size and form of the grains which appears in some cases to accompany carbonization is not accurately known.

Very numerous examples of grain from Egyptian tombs of later date are available (Fig. 3). These are invariably samples of Emmer and barley, and for several thousand years down to the end of the dynastic period, no other form of wheat than Emmer was cultivated in Egypt.

The dryness of Egypt has greatly contributed to the excellent preservation of all kinds of objects. In Mesopotamia, however, the other great centre of early civilization, the climate and damp soil have led to the destruction of most cereal grains and other plant remains, and very few specimens of grain from this region have been recovered.

From literary evidence, Hrozny concluded that the two chief cereals of ancient Babylonia were Emmer and barley, exactly as in Egypt, Emmer predominating at the earlier dates.

Two samples of great importance have been submitted to me for examination. One of these was found in 1933 by Mr. M. E. L. Mallowen in a granary during excavations of a prehistoric site at Arpachiyah, four miles east of Nineveh. Carbonized grains of barley, and a primitive, small type of Emmer were present (Fig. 5). These are the earliest grains hitherto discovered in Mesopotamia, belonging to a period 4000 B.C. or earlier. The other sample, sent by Prof. S. Langdon, of Oxford, was taken by Mr. Henry Field (U.S.A.) in 1926, from a vase on the site of an ancient Sumerian house at Jemdet Nasr, a few miles north of Kish.

Only grains of wheat were present, and these completely carbonized. They were of large average size, with blunt tips and the prominent dorsal hump characteristic of varieties of Rivet wheat (*Triticum turgidum*) (Fig. 6) which belongs to the Emmer group. I gave an account of the sample in NATURE of February 19, 1927. I consider that these grains represent an advance on the earliest forms of Emmer, resembling some superior types of Emmer now grown in Abyssinia, which are sometimes classed as Rivet wheats.

Mr. O. F. Phillips (U.S.A.) has expressed the opinion that these Kish grains are a kind of Club wheat (*Triticum compactum*), but I unhesitatingly regard this view as erroneous. There is no evidence that any wheat of the bread wheat group to which Club wheat belongs was known in any part of the world for some thousands of years after the date attributed to the Kish sample.

Mr. Henry Field records the discovery of barley grains at Jamdet Nasr, but these I have not seen.

It is hoped that archæologists will look for and carefully preserve all samples of grain which they may unearth in the investigation, paying special heed to fragments of ears and chaff, for these are of importance in the correct determination of the race or species to which they belong.

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# Biogeography and Ecology of North African Birds and Mammals

THE animal population of the northern parts of the African continent is of exceptional interest to a biologist, both by reason of the great similarity of the conditions in coastal areas to those of southern Europe, and by the striking contrast provided by the Sahara, with its extreme desert regime and highly peculiar fauna. While the fauna of North Africa in its entirety remains still very inadequately explored, our knowledge of at least two groups, birds and mammals, is sufficiently advanced for a comprehensive survey of the fauna. Such a survey is provided in a recent memoir by M. Henri Heim de Balsac*, who has based it not only on all the available literature, but also on personal explorations carried out over many years.

A careful analysis of the mammalian population of the coastal and mountainous Berberian zone reveals the somewhat unexpected fact that its relationship with the European fauna is not so close as is usually assumed. Apart from bats, three quarters of the species composing the Berberian mammalian fauna cannot be considered European, and are mostly Ethiopian in origin. Bats in this respect approach the birds, among which the majority are European; but there is a considerable proportion of unmistakable tropical forms. Since palæontological studies have shown a still lower proportion of European forms in North Africa in the earlier stages of the Quaternary period, it appears impossible to retain the idea of any post-Pliocene connexion of Europe with Africa. On the other hand, an exchange of populations with palæarctic Asia, through Libya and Egypt, must have existed until the middle of the Quaternary (Rissian) period. The Atlantic islands (Azores, Madeira, Canaries) are populated by relics of the Tertiary Mediterranean fauna, and did not play any prominent part in the origin of the Quaternary fauna of Berberia.

* Biogéographie des Mammifères et des Oiseaux de l'Afrique du Nord. (Supplément xxi au *Bulletin Biologique de France et de Belgique*.) Pp. 447 + 7 plates. (Paris: Press Universitaires, 1936.) 125 francs.

The northern limit of the Saharan zone depends on humidity, and the isohyet of 200 mm. per annum coincides almost exactly with the limits of the distribution of the desert fauna. The mammalian fauna of the Sahara is almost entirely tropical, mostly Ethiopian, in its origin, and even amongst birds the vast majority are non-palæarctic. It is, therefore, impossible to continue to include Sahara in the Palæarctic region, as is usually done.

A number of urgent problems of desert ecology are discussed in the second part of the memoir, comprising twelve chapters. There is a mass of original information, often leading to deductions which may be unorthodox, but are well supported by first-hand evidence. The distribution of mammals is very little influenced by the absence of water, since all of them are able to do without drinking, being satisfied with the water obtained from food. The same, however, is observed in mammals elsewhere, and cannot be considered as a special physiological adaptation. Among birds, only a few grain-feeding species (Pteroclidæ, etc.) cannot live without drinking, while all those with mixed diet can do so. No special adaptations exist in desert mammals for protection against powerful insolation, since the vast majority of them are nocturnal in their habits, and many pass the day underground. In birds, which are exposed to the sun, no special adaptations in behaviour have been noted.

As regards morphological adaptations to desert environment, some of the classical text-book examples do not withstand serious criticism. Thus, a statistical study of the structure of the feet in desert mammals and birds shows that, contrary to accepted opinion, there is no special dominant type of structure which can be regarded as adaptation to the environment. On the contrary, there is a great variety of structures, and some of them appear to be singularly ill-adapted to the particular habitat. Similarly, the hypertrophy of external ears considered by many authors as a typical feature of desert animals is actually not a general feature. As regards the great development of bullæ tympanicæ observed in the large majority of desert mammals, it appears to be a real response to the environment, but its physiological and biological significance is wholly obscure, and various hypotheses as to its presumed role rest on a desire to prove its usefulness to the animal, rather than on facts.

Again, a thorough discussion of the vexed problem of the coloration of desert animals does not permit the author to subscribe to its classical explanation as a protective device developed by selection. Both the hypertrophy of the bullæ tympanicæ in desert mammals, and the dilution of pigments, with the preponderance of phæomelanines and almost complete absence of carotinoids, are regarded by the author as characters which developed in strict dependance on the dryness of the environment, acting on the organism either directly, or indirectly.

Every ecologist and general biologist will find in this memoir, the contents of which are very inadequately expressed by its modest title, a store of original ideas, supported by abundant and fresh data of biogeographical, ecological, anatomical and physiological order.

B. P. UVAROV.

# Blackpool Meeting of the British Association

ALL signs point to a full and interesting meeting of the British Association on September 9–16 in its new surroundings. The work of the Association, wide enough in all conscience, has been, of recent years, taking on a still wider character. The man of science is realizing to-day, as he never realized before, that he is, as man of science, a citizen of a great community; that he is a power in that community; and that he can forge weapons of a potency, for good and ill, such as the world has never yet known. The destinies of the future civilizations are in his hands, more than in those of any other class; and it is for him to see that the knowledge which he presents so freely to his fellows is used for weal, and not for ill.

To that end, it is necessary to study, critically and minutely, the effects of the advances of science on the well-being of the community. Most of us are content to indulge in that study, so long as it is a matter of handing out bouquets; but the gifts of man to mankind may be evil as well as good, and it is precisely those possibilities of evil which demand most careful study. The new policy of the Association, of starring in its programme those items which deal with aspects of knowledge the repercussions of which on the welfare of the community are direct and important, marks an important step in the history of the Association; it is to be hoped that it will remain a permanent feature of the programme.

The subject of the presidential address (the

impact of science on society), the titles of the sectional presidential addresses, and the principal topics of discussion have already been announced in an article which appeared in NATURE of May 9 (p. 766). To these we may now add the series of public lectures and lectures to children. The series is as follows:

PUBLIC LECTURES.

*Lytham St. Annes.* Dr. Olaf Bloch: "The Scope of Photography".

*Blackpool South.* Dr. W. F. Bewley: "Science and the Glass-house Industry".

*Preston.* Prof. J. L. Myres: "Who were the Greeks ?"

*Southport.* Sir James Jeans: "Some Recent Advances in Astronomy".

*Poulton-le-Fylde.* Mr. P. A. Francis: "Applications of Science to Poultry Farming".

*Fleetwood.* Prof. C. M. Yonge: "Common Shore Animals".

*Thornton Cleveleys.* Dr. D. F. Harris: "Joy in Scientific Discovery".

*Preston.* Prof. Allan Ferguson: "Splashes and what they Teach".

LECTURES TO SCHOOL CHILDREN.

Brigadier H. S. L. Winterbotham: "How Maps are Made".

Mr. D. Seth Smith: "Favourites of the London Zoo".

Evidently the public lecture, whether to a senior or to a junior audience, is becoming an increasingly important feature of the annual meeting. It is possible that this impressive list of lectures is still incomplete, as applications are still coming in from some of the East Lancashire towns.

The Evening Discourses, to be delivered by Mr. C. C. Paterson and by Capt. F. Kingdon Ward, will deal with "Science and Electric Lighting" and with "Plant-hunting and Exploration in Tibet". These discourses are open to members only.

Some of the sectional excursions and the social events have already been announced. The Mayor and Mayoress of Blackpool (Alderman W. Newman and Miss Newman) invite members to a reception in the Winter Gardens on Thursday, September 10. The headmaster of Rossall School (Mr. H. G. M. Clarke) will entertain four hundred members at a garden party at the School on Tuesday, September 15. The Rotary Club will hold a luncheon on Thursday, September 10, when the president will address the members and their guests. The Official Service will be held at St. John's Parish Church on Sunday, September 13, when the Right Reverend the Lord Bishop of Blackburn will preach the sermon.

Thirty sectional excursions and visits have been arranged, of geological, botanical, antiquarian, engineering and educational interest. Their range in space is as wide as their range in subject. A visit to the Amusement Park stands cheek by jowl with an excursion to the Lake District, and a visit to the open-air swimming bath hard by an excursion to Garstang, Furness Abbey and the Southport Sand Dunes, Stonyhurst and Rossall, Fleetwood Fish Docks and the Fylde Farms. The members of the Association will indeed have enlarged their experiences by the time that the annual meeting draws to its close.

# Obituary

## Sir Henry Wellcome, F.R.S.

EARLY on the morning of Saturday, July 25, there passed away, at the ripe age of eighty-two years, a unique personality, whose activities ranged from archæological and geographical exploration to the creation of a great manufacturing business, and whose interests included such diverse matters as the collection of ancient manuscripts, the social welfare of native races and the provision of funds for fundamental research in those sciences on which the progress of medicine depends.

Sir Henry Wellcome was born in Wisconsin and, as the son of a frontier missionary, spent his childhood among Dakota Indian tribes. A boy whose earliest experiences included that of organizing the casting of rifle bullets for the defence of a settlement of whites, and of assisting his uncle—a well-known frontier surgeon—in treating the wounded in the Sioux War in Minnesota, was obviously well-equipped for an interesting career. He chose pharmaceutical chemistry as a vocation, and passed a period of study in Chicago and Philadelphia, where he took his diploma. His life-long interest in travel began to show itself at this stage, and he visited most parts of North America and spent some time in South America in the study of cinchona distribution in its native habitat, a subject in which his life-long interest was again manifested in the tercentenary celebration of the discovery of cinchona, which he organized in London in 1930.

Having given full play to the romantic side of his nature in these *Wanderjahre*, Wellcome looked round for a suitable centre for the exercise of his practical bent towards the pharmaceutical side of chemical industry and chose London as his future home, and here in conjunction with the late Mr. S. M. Burroughs he established in 1880 the firm of Messrs. Burroughs, Wellcome and Co. for the manufacture of fine chemicals and pharmaceutical products. The business was a success from the beginning; its products are known all over the world, and in addition to the chief works at Dartford, the firm now carries on operations in New York, Montreal, Sydney, Cape Town, Milan, Shanghai, Bombay and Buenos Ayres and has agencies in most of the world's great commercial centres.

The activities thereby engendered were not enough for Sir Henry Wellcome, and he soon began to use his resources in furtherance of the benevolent and scientific projects he had at heart. He founded at Dartford a club and institute with a park and ground for field sports, and in this and other ways spent large sums in providing technical instruction and means of mental and physical recreation for the staff and work people. In 1894, the Wellcome Physiological Research Laboratories were started, and two years later the Wellcome Chemical Research Laboratories were opened. In 1913 the Wellcome Bureau of Scientific Research was founded with the triple duty of controlling the various research laboratories already in operation, acting as a centre of information on scientific medical matters and to conduct research in biological subjects affecting the progress of medicine. Associated with it are the Entomological Field Laboratories and the Medical Museum, the latter a boon to students and remarkable for the wealth of its pathological material and the ingenuity of its illustrative methods. Sir Henry's latest and most striking gift is the magnificent building of the Wellcome Research Institution, which was described in NATURE of December 5, 1931, p. 974, and in which the organizations referred to above, with the exception of the Physiological and the Entomological Field Laboratories, are now housed.

For the greater part of his life, Sir Henry Wellcome had collected books, manuscripts, pictures and materials of all kinds illustrative of the customs and habits of primitive man and the beginnings and progress of pharmacy, medicine and surgery. These formed the nucleus of the Historical Medical Museum organized in 1913 in premises in Wigmore Street, where it rapidly outgrew the accommodation available. Of all his projects for the near future, the one nearest to the founder's heart was probably to see these cherished treasures displayed in the exhibition galleries designed for them in the new building, and it is a matter of keen regret to his friends that he did not live to see the completion of this scheme. Sir Henry's other interests can only be referred to briefly. For some years he conducted personally archæological explorations in the Upper Nile regions, discovering and excavating several important ancient Ethiopian sites, and since 1932 he has provided funds for the excavations at Tell Duweir (Lachish) of which an account appeared in NATURE of July 18, 1936, p. 135. He gave generously in funds and medical equipment to expeditions for geographical exploration, and his friendship with H. M. Stanley and his deep interest in Africa led among other things to the foundation of the Lady Stanley Maternity Hospital in Uganda, and the establishment in 1900 of Tropical Research Laboratories at the Gordon Memorial College, Khartoum.

In recent years, Sir Henry Wellcome received numerous honours and marks of appreciation of his services to research in medicine and its allied sciences. In 1932 he was elected a fellow of the Royal Society and an honorary fellow of the Royal College of Surgeons. In the same year he was created a knight, and in 1936 he received the Cross of the Officier of the Legion of Honour from the President of the French Republic, and he also had conferred on him, for outstanding services to Spain, the decoration "Comendador de la Orden de la Republica".

By the death of Sir Henry Wellcome, the world loses not only a great, but also an effective giver, for his benefactions were the outcome of a knowledge of the real, but not always obvious, means for the betterment of mankind.

## Mr. F. C. Lewis

MR. FRANCIS CHARLES LEWIS was one of five men who unfortunately met their death through an explosion at the Research Department, Woolwich, on July 8. Born at Barry, South Wales, in 1894, he was educated at the Woolwich Polytechnic and Cardiff Municipal Secondary School. He studied at the University College of South Wales and Monmouthshire, Cardiff, graduating B.Sc. (Wales) in 1915. He then joined the staff of Messrs. Nobel's explosives factory at Pembrey, where he later superintended the manufacture of trinitrotoluene. In 1918 he became a member of the Royal Flying Corps, and shortly after the Armistice was appointed technical research chemist by Messrs. British Dyestuffs, Ltd.

In 1921, Mr. Lewis was appointed research chemist on the staff of the Explosives Branch of the Research Department, Woolwich, where his work has been almost entirely concerned with the application of high explosives to the requirements of the fighting services and with improvements in the methods of using these explosives to obtain the highest efficiency. This has included both explosives already in use and new explosives. Research of this type naturally calls for careful precautions in all its stages, and appropriate safeguards are applied to minimize the risks. These precautions have been generally successful, as is shown by the fact that the Explosives Branch has had only one previous fatality due to explosion since it came into existence in 1901.

Mr. Lewis's work has been of great value and his experience of high explosives has greatly assisted in the progress of the work. His loss will be much felt by his colleagues and friends. Mr. Lewis was married in 1920, and leaves a widow and four children.

G. R.

# News and Views

### Chronology of Early Man and Cultural Associations

IN his recent presidential address to the British Speleological Association (see NATURE of August 1, p. 194) Sir Arthur Keith, when arguing for a parallel evolution in the development of modern races from primitive ancestral forms in their respective continental areas, demonstrated the connexion between the Australian and *Pithecanthropus* of Java, with the aid of mid-Pleistocene Solo man as the connecting link between the early Pleistocene *Pithecanthropus* and the late Pleistocene form of that region, Wadjak man. There would now appear to be a possibility that the chronological position of the undoubtedly archaic form discovered in the gravels of the Solo river at Ngandong, Java, in 1932, may be called in question. In another column of this issue of NATURE (see p. 293) reference is made to a communication from Dr. P. van Stein Callenfels, the distinguished Dutch authority on the archæology of Indonesia, appearing in the current issue of *L'Anthropologie*, in which he points out that the cultural associations of Solo man, harpoons and axes of stag horn, are such as in a European context would denote an antiquity of not more than nine or ten thousand years. While the early dating of Solo man has been generally accepted hitherto, if, as is stated, these artefacts are apparently beyond question contemporary with the human relics, this would appear to demand re-examination of the geological data. If further consideration supports Dr. Callenfels' argument, like the evidence of the Swanscombe skull in relation to the position of Piltdown man (see NATURE, August 1, p. 200), it would suggest that the current phylogenetic scheme, while valid as a logical classification, is an uncertain guide to chronology, and that the evolution and descent of man has been a far more complex process than has been demonstrated hitherto.

### Spiritual Healing

AT the Methodist Conference held at Newcastle in July, the report of a Committee on Spiritual Healing was read by the Rev. Leslie D. Weatherhead (*Methodist Recorder*, July 23). He declared it to be an interim report only, and expressed the hope that the Committee would be reappointed. The report is cautious in tone, recognizing that the subject is full of difficulties. The trouble from the scientific point of view is that what appear to be like causes do not necessarily produce like effects. "We pray for one man and he gets better; we pray for another and he does not—and we don't know why in either case." Of course, in healing, the individual factor is the important one, and this makes scientific generalizations almost impossible. The only thing to do, presumably, is to record a large number of cases as accurately as possible, and to extract from them whatever may seem to establish some sort of a regular law of behaviour. Or, as the report puts it: "the work which lies before students of this subject must include research into those conditions under which those energies which sweep through personality may be set free to do their work." The report wisely says: "We felt all along that a method is not less a manifestation of the Divine because it is understood." As for "orthodox" medical science, "We believe no method [of spiritual healing] is to be welcomed which brushes aside as irrelevant the amazing findings of modern medicine and surgery." It is indeed all to the good that religious bodies such as the Methodist Church should interest themselves in the systematic study of the psychological causes of physical health and sickness, and the report of this Committee is for that reason important.

### J. C. Loudon and the Waterloo Beeches

REFERRING to the note in NATURE of August 8 (p. 237) in which this excellent story was mentioned, a correspondent points out that there are many variants of it extant. Sir William Fraser's version, which is by far the most detailed, bears all the signs of study of the original sources. It would spoil the story to condense it; let the worthy baronet tell it in his own inimitable, if stilted, fashion.

"The Duke of Wellington . . . received a letter . . . from the eminent landscape designer and great authority on botanical matters, J. C. Loudon. It was . . . to this effect:

" 'My lord Duke: It would gratify me extremely if you would permit me to visit Strathfieldsaye, at any time convenient to your Grace, and to inspect the Waterloo beeches. Your Grace's faithful servant, J. C. Loudon.'

"The Waterloo beeches were trees that had been planted immediately after the battle of Waterloo; as a memorial of the great fight. The Duke read the letter twice, the writing of which was not very clear; and, with his usual promptness and politeness replied as follows; having read the signature as 'C. J. London' instead of 'J. C. Loudon':

" 'My dear Bishop of London, It will always give me great pleasure to see you at Strathfieldsaye. Pray come there whenever it suits your convenience, whether I am at home or not. My servant will receive orders to show you so many pairs of breeches of mine as you wish; but why you should wish to inspect those that I wore at the battle of Waterloo is quite beyond the comprehension of Yours most truly, Wellington.'

"This letter was received, as may be supposed, with great surprise by the Bishop of London. He showed it to the Archbishop of Canterbury, and to other discreet persons: they came to the melancholy conclusion that the great Duke of Wellington had evidently lost his senses. The Bishop of London (Blomfield) declared that he had

not written to the Duke for two years; and to receive this extraordinary information puzzled the whole Bench of Bishops."

So far Sir William Fraser, whose account may be regarded as authoritative. Fraser (1826–98, Eton, Christ Church, and 1st Life Guards) worshipped the memory of Wellington with a devotion that almost reached fanaticism; his "Words on Wellington", from which this account is taken, is one of the most remarkable collections of sayings and doings that have ever been recorded concerning one individual—remarkable not only in the variety of its Wellingtoniana, but in the insight which it gives into the character of its compiler. The book is long out of print, and has a certain historical value. The author carried out a first-rate piece of detective work, of which he gives a full account, in his identification of the scene of the Duchess of Richmond's famous ball on the eve of the battle of Waterloo.

### Scientific and Industrial Research in Australia

THE Australian Government has announced that the work of the Council for Scientific and Industrial Research is to be extended in the interests of secondary industry generally. Since its establishment in 1926, the Council has deliberately restricted its attention to problems of the primary producing industries, though no such restriction is imposed upon it by the Act under which it is constituted. It has always been assumed that an extension was only a matter of time in view of the contraction of world markets for primary products and the consequent pressure to increase the home market by expanding secondary industries. A recent decision to establish aircraft and motor production in the Commonwealth has intensified a growing demand for an extension of national scientific research, and an influential committee, including leading engineers and industrialists, is now at work preparing a definite scheme of work. Existing institutions will be utilized wherever possible, but it is fully recognized by the Government that considerably increased financial obligations must be carried by it. A first step is to establish an agency for the maintenance of accurate fundamental standards of measurement and for the testing of master gauges for controlling precision manufacture. It is intended that in all developments intimate contact shall be maintained with, and guidance sought from, established British institutions engaged on work of the same type.

### Luminous Phenomena on the Sea during a Thunderstorm

THE occurrence, during a tropical thunderstorm between Singapore and Bangkok on the morning of May 21, 1936, of a diffused white light over the surface of the sea, pulsating at regular intervals of about two to the second, so that the ship seemed to be sailing through waves of light and darkness, was referred to by a correspondent in *The Times* of June 26. The phenomenon is said to have continued for about half an hour. Another correspondent referred to a similar phenomenon in the Persian Gulf in March 1908, when waves of light were observed wheeling round the ship. Both these phenomena would appear to have been due not to electrical conditions but to phosphorescence. A description and sketch of a "Phosphorescent Wheel" near Sumatra (with an interval of about one second between the waves of light) is given in the *Marine Observer* of the Meteorological Office of November 1926; waves of light with an interval of half a second were observed on October 27, 1924, at 1 a.m. near Krakatoa Island (*Marine Observer*, October 1925); streaks of luminescence, observed in January 1927 in the Equatorial Atlantic, were practically parallel with the wind, which was south-east, about force 4 (*Marine Observer*, January 1928). These observations indicate that phosphorescence is not uniform over the wave profile, and consequently streaks of light will appear to an observer on board ship to move as the ship moves relative to the waves. Phosphorescence is most readily observed on ripples or on the breaking crests of waves, and while no one has yet worked out in detail the conditions under which the streaks will appear, the period of pulsation, which is reported as 0·5–1 second, is probably equal to the interval of time between the passage of the ship over successive waves.

### Lightning and Atmospherics

IT is now generally agreed that the majority, if not all, the atmospherics encountered in radio communication originate in lightning flashes. When the storm is close to the receiver, it is possible to identify the stronger atmospherics with the neighbouring flashes. In a recent communication, Mr. P. F. Fyson, Langherne House, Rushwick, Worcester, claims to have observed that the atmospheric crackle produced on a broadcasting receiver was heard before the lightning flash which caused it was perceived visually. If this difference in the perception of the two effects is real—it obviously needs verification by other observers—it would appear on first consideration that the human eye is rather more sluggish in its operation than the ear; and Mr. Fyson suggests that this may be due to the time required for the chemical change in the retina to affect the optic nerve. An alternative explanation, however, may be found in the fact, which has arisen from recent research on lightning, that an intermittent electrical discharge appears to precede the actual main lightning flash. It is possible that this discharge may be invisible and yet may be capable of producing audible effects on a wireless receiver. These sounds may thus be heard a very short time before the visible flash was observed.

### Champollion and Hieroglyphics

IN "Science News a Century Ago", in NATURE of August 8 (p. 257), an extract appears from the *Athenæum* describing an obelisk erected to the memory of Champollion, and bearing the inscription "To the memory of F. J. T. Champollion, who first penetrated into the mysteries contained in the writing and monuments of ancient Egypt. . . ." A correspondent has pointed out that, even allowing

for the generosity of interpretation of a 'lapidary inscription', Champollion has no claim to the honour of first penetrating into the mysteries of the writing of ancient Egypt. That honour, beyond all question, belongs to our versatile countryman, Thomas Young. In 1819, Young published an article, "Egypt", in the supplement to the "Encyclopædia Britannica", in which he gave a list of *alphabetic and syllabic characters*, an article which has been described by Sir E. A. Wallis Budge as "practically the foundation of the science of Egyptology". In 1821, two years later, Champollion published a treatise in which he shows not the slightest trace of knowledge of anything alphabetic in hieroglyphic or hieratic characters; Champollion's publication of an alphabet dates from 1822. Concerning Champollion's alleged attempt to suppress his unfortunate work of 1821, we need say nothing here; the whole story of the Rosetta Stone and the decipherment of the hieroglyphic characters was discussed some years ago in an article in NATURE (April 30, 1932, p. 638). It is sufficient here to say that the inscription on the tablet to the memory of Young in Westminster Abbey states no more than the bare truth when it describes him as the one who "first penetrated the obscurity which had veiled for ages the Hieroglyphics of Egypt".

### Recent Acquisitions at the Science Museum

AMONG the objects recently placed on exhibition in the Science Museum, South Kensington, is a model of the complete lay-out for a 120-ton 10,000 horse-power Mond gas producer plant with ammonia recovery apparatus which has been lent by the Power-Gas Corporation, Ltd. Mr. Edward J. Willis, an American authority on astronomical navigation, has sent from the United States an example of a navigating machine which was invented by him and constructed at a cost of about £300. The machine solves problems in spherical trigonometry connected with navigation. An example of Selling's calculating machine which has long lain neglected in the stores of the Imperial College of Science and Technology has been lent to the Museum for exhibition. The machine was invented fifty years ago and made ingenious use of the 'lazy tongs' mechanism in order to perform multiplication and division. A representative selection of fourteen stone (chert) weights and a plaster cast of a fragment of a linear measure, all found in excavations at Mohenjodaro, Harappa, and elsewhere in northern India—relics of a civilization of *c.* 3250–2750 B.C., that formed great cities along the Indus valley, contemporaneous with the ancient Egyptian first to fifth dynasties, and the ancient Sumerian kingdoms in Mesopotamia—have been presented by the Archæological Survey of India.

### Frontier System in Roman Scotland

A FURTHER effort to settle the question of the number and character of the occupations of the Roman fort of Birrens, near Ecclefechan, Scotland, is being made by excavations now proceeding in charge of Mr. Eric Birley, of the University of Durham. The problem to be solved is whether the occupation of the fort was part of the organization of the Antonine Vallum, as Sir George Macdonald has suggested, or whether it is to be related to Hadrian's Wall, as the Dere Street forts to the east recently have been shown to be by Mr. Ian Richmond's excavations. Two periods of occupation separated by a destruction were demonstrated in 1925 by excavation, but the examination of the stratification was not, nor was it intended to be, exhaustive. Search for further evidence is now being made, and with this object excavations are proceeding at two points down to the subsoil for a thorough examination of the stratification and the pottery. Up to the present, a section in the *retentura* of the fort, it is reported in *The Times* of August 10, has shown that a wooden building and two of stone preceded the two periods, of which evidence was found in excavations made in 1895. The wooden structure is assigned to the latter part of the first century and it is said that traces of Agricola have been found; while the two stone periods which follow are thought to belong to the Antonine occupation. Under the earlier of the two periods previously known, two vessels have been discovered, for which there are parallels from Hadrian's Wall. A second excavation in the *prætentura* has been more fruitful as a source of pottery and other finds, including a large piece of a cut-glass bowl, of which a fragment was found in 1895. Excavation at the west gate has exposed what is described as "the worst Roman masonry so far found in Scotland".

### Archæological Finds in Iraq

DR. HENRI FRANKFORT'S assiduity in making known to the public at an early date any points of special interest arising out of the excavations of which he has been in charge, season by season, is worthy of all commendation, especially since he became field director for the Oriental Institute of the University of Chicago at Tell Asmar, the ancient Eshnunna. The important and extensive operations of the Oriental Institute in the field of the Ancient East possibly are not so widely known, outside the circle of specialists, as they deserve. In his report on the results of the past season (*The Times*, August 1), Dr. Frankfort mentions a number of finds of exceptional interest. As is generally known, one of the objects to which he has given special attention at Tell Asmar and on the neighbouring site of Khafaje is the problem of the early relations of Mesopotamia with both the Indus Valley and the Mediterranean. On both these questions he is able to record new and important evidence, in the former instance pointing to a more intimate relation than the purely commercial connexion, which is all that it has been possible to infer from previous finds. In a temple on a new site, Tell Agrab, the expedition has found among a quantity of interesting material some remarkable examples of stone vases with surprising sculptures. Among these is one fragment which shows the sculptured figure of a humped bull standing before a manger and enclosed in the poles of arches which support a roof. Not only is this a

common motif at Mohenjo-daro, but also it belongs to a cult as alien to Mesopotamia as is the humped bull itself. Its occurrence at Tell Agrab should point to a more than casual or commercial contact. Similarly a further link with the Mediterranean is afforded by a terra cotta relief from a small shrine at Tell Asmar, in which one of the figures, possessing one eye only, and associated with fire, is identified as a cyclops. It is interesting to note how many of the interesting series of finds recorded this year by Dr. Frankfort, such as the bowls which had contained a live snake, are to be referred to cults, popular or otherwise, upon which at present we have no information.

### Systematists and Text-Books

IN a recent issue of the *Nederlandsch Tijdschrift voor Geneeskunde* (80, 15, pp. 1675–1677; 1936), Dr. L. D. Brongersma directs attention to the deplorable results which can arise through a lack of understanding of the principles of systematic zoology and zoological nomenclature. As an example of his thesis, Dr. Brongersma surveys the most recent edition of a standard text-book of vertebrate comparative anatomy. The confusion to the student which must arise through different authors using different names for the same animal can scarcely be avoided until the systematists have set their house in order, but there can be no possible excuse for the use of two or more names for the same creature within a single chapter; yet that has happened on numerous occasions. Perhaps even more inexcusable are errors arising from the careless confounding of similar names of very different animals. Dr. Brongersma finds that *Hemidactylus* (a gecko) appears amongst the Urodeles, due to confusion with *Hemidactylium*, and *Neomeris* (intended for a porpoise, but strictly applicable to a polyzoan) is confused with a tortoise and is discussed as a reptile! Further difficulties are due to faulty transcription and proof-reading, which have produced a crop of apparently new names, such as *Chelonia speciosa* written instead of *Chelonia sp.* and *Gecko vertic* intended as an abbreviation of *Gecko verticillatus*. The evils attendant on nomenclatorial changes can certainly be minimized by closer co-operation between teachers of zoology and systematists and by a better understanding of the difficulties which confront the latter in the search for stability. It is consequently gratifying to learn that, as a result of Dr. Brongersma's article, a list of corrigenda will be published in the next volume of the particular work he has criticized, and this will itself be submitted to competent systematists before publication.

### A Fire in the Mersey Tunnel

SOME of those who have driven through the three miles long Mersey Tunnel may have thought that it was unnecessary to place fire alarms at distances of fifty yards apart throughout the tunnel and to take the many other special precautions against fire which are described in guide books. Remembering that it cost eight million pounds to build and that 5,000 vehicles per hour use the tunnel, it was necessary to take every precaution. The first test of the fire alarm installation occurred on July 25, when a lorry carrying cinematograph films from Liverpool to Birkenhead burst into flames inside the tunnel. The driver at once gave the alarm from one of the fire-alarm boxes, and in less than five minutes the Liverpool and Birkenhead fire brigades had put out the fire. An alarm given at any one of the ninety-eight special boxes is received at both the brigade headquarters. At the same time, large neon 'stop' signs on the roof close the tunnel to traffic, and the pay boxes at each entrance are warned by bells and red lights. The 'electromatic' vehicle-actuated traffic signals are automatically interlocked and allow vehicles to leave and prevent them from entering the affected portions of the tunnel. The alarm is also given to the ventilation control room, from which the large electric air fans can be regulated to meet requirements of any situation that may arise.

### The Economics of Railway Electrification

THE *Engineer* of July 17, 24 and 31 contains three short articles on main-line electrification abroad, which are devoted to a statistical survey of the financial aspect of electrification. That electric traction has great advantages for suburban traffic and where water-power is plentiful and coal dear is generally admitted, but the fact that only 2½ per cent of the total railway mileage in the world is electrified will, perhaps, come as a surprise to those who advocate the adoption of electrification on a wide scale in Great Britain. Of all European countries, in only one, Switzerland, does electrified mileage predominate, and in only six out of twenty does it exceed trifling proportions. Commenting on this, the *Engineer* says: "It is impossible to believe that this neglect of electrification is due to the supineness and conservatism of so many nations. When it is observed that the German national railway system is only electrified to less than 4 per cent, those who are firmly convinced that there is no more technically progressive nation in the universe will have to admit that the arguments against electrical operation must have been overpowering." Electric traction is undoubtedly an extremely efficient means of transport, but against this has to be put the very high capital costs involved. The arguments against electrification have also been strengthened by the great improvements recently made in steam locomotives and the introduction of Diesel-electric units.

### German Road Progress

ALTHOUGH it is only two years since Munich entertained the seventh International Road Congress, the city is holding another road congress and in addition a large exhibition of road building machinery on September 16–27. The Research Department of the German State Highways Commission and the leading road construction firms are in charge of all the arrangements. In *Roads and Road Construction* of August 1, Dr. Otto Reismann outlines the programme for the Congress. He points out that the

present road construction programme in Germany is on so large a scale, and has been pushed forward so rapidly that great improvements in technical matters have ensued in connexion with road and bridge construction. At the Congress these will be discussed by Government, scientific and industrial experts. The road building machinery exhibition will be held in the open on the Munich Fair Ground, and will show the visitors the very rapid progress made in the mechanization of road construction. The quality of the materials used and the design of the machines have been vastly improved. The Congress will not be confined to purely business sessions. The German motor roads are not built merely for transport purposes. An attempt has been made to build them in such a way that they are in harmony with the landscape and the country in which they lie. Included therefore in the Congress programme are excursions and journeys of inspection over specially constructed motor roads and over the German Alpine highways. At the same time as the Congress there will be an art exhibition on roads as seen by modern art. This is an attempt to demonstrate the strong impression modern art has received from the inspiration of the new roads. It is anticipated that the first 600 miles of the new motor roads (*autobahn*) will be thrown open to traffic in the coming autumn. In two years time, thoroughfares will be completed between Hamburg and Karlsruhe, Stettin and Munich, Ruhr and Karlsruhe, and Stuttgart to Salzburg via Munich.

### Crops and Livestock in England and Wales

THE Ministry of Agriculture and Fisheries has recently issued the first part of its publication, "Agricultural Statistics, 1934", entitled "Acreage and Production of Crops and Number of Livestock in England and Wales" (London: H.M. Stationery Office, 1*s*. 6*d*. net), a report which summarizes the annual returns from all holdings exceeding one acre. An outstanding feature is the arrest of the continuous change from arable to grass that has been going on since the Great War, the area under permanent grass showing a reduction on the previous year, whereas the total area under corn has expanded during the same period. As regards roots, the acreage under sugar beet reached a new record figure; that under fodder roots and potatoes, on the other hand, showed a decline. Yields were generally high, being above the average for all corn crops, potatoes, mangolds, hops and several kinds of fruit, though appreciably below normal for hay, turnips and swedes. The numbers of cattle, dairy cows, pigs and poultry have risen since 1933, whereas those for sheep and horses have declined, and as might be expected the output of meat and livestock products, eggs and milk have all shown considerable increases, while the wool clip was substantially reduced. An interesting feature of the report lies in the attainment of many record figures, the yield of wheat and apples being attributable no doubt to the favourable season, and the output of dairy and poultry products to the increase in numbers of cows and birds maintained. Records in area, total production and yield per acre were also reached in the case of sugar beet, while the area under oats, turnips and swedes fell to the lowest figure yet attained, reflecting the changes that are taking place in farming practice.

### Mining and Fuel Research at Sheffield

WE have received from the University of Sheffield a report on the research work done in the Departments of Mining and Fuel Technology during the year 1934–35. The former includes numerous subjects, such as mine ventilation, mine lighting, research on trailing cables, accuracy of mine surveys (in which we miss, however, any reference to the very valuable work done by the Institution of Mine Surveyors), subsidence resulting from mining operations, gas testing, movement of firedamp, fireproofing of mine timber, whilst in the Department of Fuel Technology the composition and decomposition and analysis of coal have been carefully studied. The formation of coke, the combustion of coke and the testing of coke have also received attention. A perusal of this pamphlet cannot fail to be of interest to colliery managers.

### Symbols for Heat and Thermodynamics

AN attempt will be made to relieve the present chaotic situation with regard to symbols for equations in thermodynamics at an international conference which has been called by the American Society of Mechanical Engineers, to be held in New York on September 14–15, 1936. The Conference has been arranged for this time so that some of the delegates to the World Power Conference to be held the week previous in Washington, D.C., may also act as representatives at the Symbols Conference. American usage in regard to such symbols has become fairly well standardized; but other lists have been issued by various European bodies. The Conference will endeavour to compromise the differences in the several lists.

### Fifty Years of West Ham

THE jubilee of the incorporation of the borough of West Ham has been the occasion for the publication of a volume illustrated by maps, photographs and old prints on the history and past and present activities of the borough ("Fifty Years a Borough". Edited by D. McDougall. West Ham County Borough Council 1936). The chief scientific interest in this municipal enterprise is the full account of the growth of the borough from Anglo-Saxon times and its relationship to the Lea and other rivers which were important influences in deciding direction of growth. The chapters on the local government and social services are also of considerable interest.

### Sterilization Operations in the United States

ACCORDING to a Science Service bulletin, steady increase in sterilization operations performed on insane and feeble-minded patients in the United States is reported by the Human Betterment Foundation, Pasadena. A total of 23,092 such operations

had been officially performed up to January 1, 1936. This does not include operations of this nature privately performed, but is limited to those performed under State laws in the institutions of the twenty-eight States now having sterilization laws in force.

### Announcements

PROF. J. BASIL BUXTON, professor of animal pathology in the University of Cambridge, and director of the Institute of Animal Pathology and of the University Field Laboratories, Cambridge, has been appointed acting principal and acting dean of the Royal Veterinary College from September 25, and to succeed Sir Frederick Hobday as principal and dean on the retirement of Sir Frederick after the opening of the main block of the new college buildings.

AT a recent meeting of the North East Coast Institution of Engineers and Shipbuilders the following awards were made: *Institution Gold Medals* (Engineering), to Eng. Comdr. C. J. Hawkes and G. F. Hardy, for a paper entitled "Friction of Piston Rings"; (Shipbuilding), to R. C. Thompson, for a paper entitled "Modernizing the Motor Vessels 'Silverpine' and 'Silverlarch' and Increasing Their Service Speed"; *M. C. James Medal*, to W. C. S. Wigley, for a paper entitled, "The Theory of the Bulbous Bow and Its Practical Application"; *Institution Scholarship*, to Anthony Gilchrist; *Thomas Fenwick Reed Medal*, to Dr. Will Pratt.

THE second International Congress of the International Association for Testing Materials will be held in London on April 19–24, 1937, under the presidency of Sir William Bragg. The Congress will be open to anyone on payment of membership fee. The subjects selected for discussion will be classed into the following groups: A, Metals; B, Inorganic Materials; C, Organic Materials; D, Subjects of General Importance. Further information can be obtained from the honorary secretary, Mr. K. Headlam-Morley, 28 Victoria Street, London, S.W.1.

DR. MAX BODENSTEIN, professor of physical chemistry at Berlin, has been awarded the Bunsen Medal by the German Bunsen Society for applied physical chemistry, and Dr. Max Le Blanc, professor of physical chemistry at Leipzig, has been elected an honorary member of the Society.

DR. DONALD D. VAN SLYKE, a member of the Rockefeller Institute of Medical Research, has been awarded the Charles Mickle fellowship of the University of Toronto for his work on blood analysis, respiratory and renal reactions, diabetes and nephritis.

A MINISTRY of Health has recently been formed in Belgium under the direction of M. Emil Vandervelde, the well-known Socialist leader.

THE twenty-fifth Congress of the German Physiological Society will be held at Giessen and Bad Nauheim on August 30–September 2 in conjunction with the German Pharmacological Society. Further information can be obtained from Prof. Dr. Burker, Physiologisches Institut, Giessen.

THE twenty-third French Congress of Hygiene will be held at the Institut Pasteur, Paris, on October 20–22, under the presidency of Prof. Leclainche. Further information can be obtained from the general secretary, Dr. R. Dujarric de la Rivière, Institut Pasteur, 28 rue du Docteur Roux, Paris, 15^e^.

FOUR committees (medical, engineering, economic and legal, and administrative) have been appointed in the United States, consisting of health experts, representatives of employers, workers, insurance companies, Government, technical societies and engineers, to attempt to devise a method for putting an end to silicosis.

EIGHTY-SIX cities in the United States with an estimated population of 37 millions reported 8,799 deaths from motor accidents in 1935 as compared with 9,060 deaths in 1934. Forty-eight of the cities showed a decrease in the total number of fatalities; thirty-six showed increases and two cities reported the same number of deaths in 1935 as in 1934.

THE fifteenth Annual Clinical and Scientific Session of the American Congress of Physical Therapy will be held at the Waldorf-Astoria Hotel, New York, on September 7–11. The programme will include symposia on short-wave diathermy, hydrotherapy, exercise, electro-resection, fever therapy, treatment of vascular diseases, the educational aspects of physical therapy, the relationship of physical technicians to physicians and hospital departments, and technical and scientific exhibits. Further information can be obtained from Dr. Norman E. Titus, 730 Fifth Avenue, New York.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Two assistant experimental officers (Grade *D*) (physics or engineering) in a War Department at Woolwich—The Superintendent, Experimental Signals Establishment, Woolwich Common, S.E.18 (August 18).

A scientific officer (physics or engineering), in a Government establishment of the War Department—The Secretary, Royal Engineer Board, Regent's Park Barracks, Albany Street, N.W.1 (August 26).

A chemist in the Department of War Department Chemist—The Under-Secretary of State (C.5), War Office, S.W.1 (September 7).

An assistant keeper in the Science Museum, South Kensington, S.W.7—The Director (September 7).

An Elder professor of anatomy and histology in the University of Adelaide—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1 (September 20).

A temporary lecturer in zoology in the University of Cape Town—Prof. T. A. Stephenson (October 5).

A lecturer in civil engineering and building in the Portsmouth Municipal College—The Registrar.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 292.

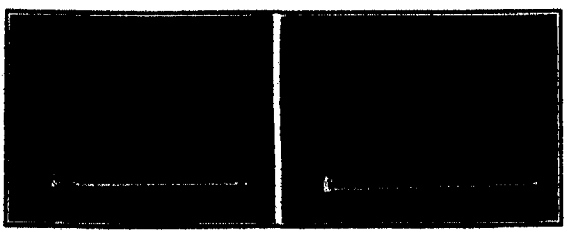
CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Some Observations on the *C* Regions of the Ionosphere

RECENT observations at Calcutta[1,2], at Morgantown (U.S.A.)[3] and Orfordness (England)[4] have established beyond doubt the existence of ionized layers much below the Kennelly-Heaviside *E* layer. Not infrequently these layers act as good reflectors of radio waves. The topmost of these layers (sometimes called the *D* layer) is situated at an average equivalent height of 55 km. The next one lies between 20 km. and 35 km., and the lowest ones appear to be situated within the tropospheric region between heights of 5 km. and 15 km. (It has recently been suggested by Mitra[5] that since the designation *D* is usually applied to the non-deviating absorbing 'tail' of the *E* region, the new regions be called *C* regions. It would perhaps be convenient to call them, starting from the top, $C_1$, $C_2$, and $C_3$ regions.)

Since data regarding the properties of these regions --particularly of the lower ones--are still lacking, we have recently carried out a series of 24-hour observations, at intervals of one hour and a half, using a frequency range of 1–15 mc./sec. The results of our observations are summarized below.

(1) Echoes from $C_1$ (55 km.) are much more frequent and are of greater strength than those from $C_2$ and $C_3$. $C_2$-echoes (25–30 km.) are also strong and are more frequent than $C_3$-echoes; the latter are weak and are observed on rare occasions. $C_1$, *E*- and *F*-echoes of moderate strength have been observed on several occasions to occur side by side.



*a* *b*

FIG. 1. Echoes from: (*a*), $C_1$ region (55 km.); (*b*), $C_2$ region (20 km.).

(2) Echoes recorded during day-time are invariably weaker than those recorded during the night. The intensities of $C_1$- and $C_2$-echoes have occasionally been found at night to be comparable with those of fairly strong *E*- and *F*-echoes.

Fig. 1*a* shows a $C_1$-echo (55 km.) with 3 mc./sec. frequency as received at midnight of June 5. Fig. 1*b* shows a $C_2$-echo (20 km.) with a frequency of 2·18 mc./sec. recorded at 1900 hours on June 12. A closer examination will reveal the presence in Fig. 1*b* of another very low height echo (8 km.) and traces of single and double reflections from the *E* region.

(3) Echoes have been observed at all times of the day and night; but they seem to be more frequent during the afternoon and are usually too weak to be detected at about midday.

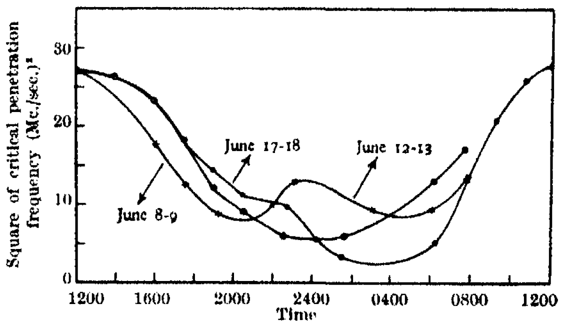



FIG. 2. Hourly variation of the square of the critical penetration frequency (noon to noon) of the $C_1$ region (55 km.) on three typical days.

(4) Curves in Fig. 2 represent hourly variation of the square of the penetration frequency ($f^2$) for the $C_1$ region for three selected days and are typical of those usually obtained in the course of our observations. It is evident that the ionization in general attains its daily maximum at about noon, and tends to a minimum during the small hours of the morning. There are also at times abnormal variations which appear to be more pronounced at night. The general nature of the hourly variation, however, leads one to conclude that the ionization is of solar origin.

(5) The critical penetration frequencies of the $C_2$ and $C_3$ regions have been obtained occasionally. But the occurrence of these echoes, particularly those from $C_3$, is not frequent enough to enable one to study the hourly variation of ionization of the corresponding regions. It may, however, be mentioned that the average values of the penetration frequencies are of the same order as those for the $C_1$ region.

The observations described here were carried out at the suggestion of Prof. S. K. Mitra.

H. RAKSHIT.
J. N. BHAR.

Wireless Laboratory,
University College of Science,
Calcutta.
June 22.

[1] S. K. Mitra and P. Syam, NATURE, **135**, 953 (1935).
[2] S. K. Mitra and J. N. Bhar, *Science and Culture*, **1**, 782 (1936).
[3] R. C. Colwell and A. W. Friend, NATURE, **137**, 782 (1936).
[4] R. A. Watson Watt, L. H. Bainbridge Bell, A. F. Wilkins and E. G. Bowen, NATURE, **137**, 866 (1936).
[5] S. K. Mitra, NATURE, **137**, 867 (1936).

IN connexion with the above observations of Dr. Rakshit and Mr. Bhar on the *C* regions, I would like to point out that it is not justifiable to take the hourly variation of $f^2$ as proportional to the variation

of the ionization density ($N$) in these low regions of the ionosphere. The collisional frequency ($\nu$) is high at such levels, and in the $C_1$ region it is perhaps comparable with $2\pi f$. Conditions favourable for reflection (or penetration) may be brought about either by an increase (or decrease) of $N$ or by a decrease (or increase) of $\nu$. It is quite conceivable that the atmospheric density and, along with it, $\nu$, varies from hour to hour at such levels, and the abnormalities observed in Fig. 2 may have been caused either by a variation of $N$ or by a variation of $\nu$ or by both occurring simultaneously.

S. K. MITRA.

London.
July 5.

## Existence of a Surface Wave in Radio Propagation

IN the mathematical development of the problem of radio propagation over plane earth, Sommerfeld[1] expressed his solution in the form of three terms, one of which he identified with the surface wave of Zenneck[2]. Curves calculated from Sommerfeld's formula have been given by Rolf[3]. Weyl[4], approaching the problem in a different manner, obtained a solution which did not explicitly contain this term. A formula given by Norton[5] gives values agreeing with Weyl. It appears that Weyl was of the opinion that his result was numerically equivalent to that of Sommerfeld. The purpose of this letter is to point out that this is not true, that the evaluation of Sommerfeld's formula by Rolf differs from the formulæ of Weyl and Norton by exactly the 'surface wave' component, and to give the results of a recent experiment showing the Weyl–Norton values to be the correct ones, which raises a question as to whether surface waves do or do not physically exist.

Previously available experimental data that might be used to decide which expression is correct have, unfortunately, been obtained under conditions for which Sommerfeld and Weyl do not differ greatly. For ultra-short wave propagation over deep freshwater, however, their results differ enormously. To make a test under these crucial conditions, an experiment on the propagation of 2-metre waves has been conducted over Seneca Lake, New York State. The variation of the field with distance was found to agree well with Weyl. At a distance of about 1·8 km., where Sommerfeld's formula gives values about 1,000 times that of Weyl, the field was studied as a function of antenna height and polarization. Whereas Sommerfeld's expression for the surface wave gives values decreasing with height, the measured field actually increased. At the greater heights, the field was independent of polarization, as it should be if there were no surface wave. Since there is no uncertainty in the correct formula to use for horizontal polarization, this comparison showed that the field at the earth's surface was about 0·001 of the value predicted by Sommerfeld. It seems evident that a revision of the Sommerfeld–Rolf curves is required for propagation over all types of ground for which the dielectric constant cannot be neglected.

CHAS. R. BURROWS.

Bell Telephone Laboratories, Inc.,
Deal, New Jersey.
July 14.

[1] A. Sommerfeld, *Ann. Phys.*, 4, 28, 665 (1909); *Jahrb. drahtl. t.u.t.*, 4, 157 (1911).
[2] J. Zenneck, *Ann. Phys.*, 4, 23, 846 (1907).
[3] B. Rolf, *Proc. Inst. Rad. Eng.*, 18, 391 (1930).
[4] H. Weyl, *Ann. Phys.*, 4, 60, 481 (1919).
[5] K. A. Norton, NATURE, 135, 954 (1935).

## Specific Ionization of Cosmic Radiation

AFTER Danforth and Ramsay's recent publication[1] I think it would be of interest to give here briefly the results of similar work, carried out last year, the conclusions of which have been proposed as a thesis at the University of Brussels (April 29, 1936) but cannot be published *in extenso* in a periodical before December next.

The problem is to measure the specific ionization of a penetrating radiation (cosmic radiation, fast electrons, etc.) by the comparison of the efficiency of a Geiger-Müller counter (single impulse or coincidence) corresponding to different internal pressures.

This method was indicated by Tuwim[2] in 1931, and by us[3] in 1933. The integration necessary for the determination of the mean length of the internal path was resolved by Tuwim and Kolhörster[4] (1933) in a particular case; unfortunately, that case was not very convenient for the precise determination of specific ionization.

I have solved that integration graphically and numerically with sufficient approximation (error less than one per cent) in the general case of two identical counters, parallel, connected for counting coincidences.

This calculation shows that the approximate formula used by Danforth and Ramsay, and by me in 1933, was definitely different from the true one (more than five per cent discrepancy). I had also shown *experimentally* that a *single pair of ions* gives a discharge of the counter with a probability of 0·999; the corrections due to showers, accidental coincidences, recovery time, latent time, barometric effect, etc., have been discussed and taken into account.

The counters used had an over-voltage range of the order of 1,000 volts, a reproducibility better than 0·5 per cent during many months, and a residual frequency of impulses that may be neglected.

The following results were found: Total cosmic radiation:

Specific primary ionization:

| | |
|---|---|
| Hydrogen | 5·96 ± 0·07 cm.$^{-1}$ (0°–760 mm.) |
| Helium | 5·96 ± 0·15 ,, |
| Argon | 29·40 ± 2·0 ,, |

Specific total ionization:

| | |
|---|---|
| Argon | 71·40 ± 2·0 ,, |

Absolute intensity of cosmic radiation (number of rays crossing per second a sphere of 1 cm.$^2$ of cross-section):

Brussels (reduced to sea-level) (760 mm.):

$$0{\cdot}0266 \pm 0{\cdot}0003 \text{ cm.}^{-2} \text{ sec.}^{-1}.$$

The concordance between the experimental results and the calculated curve (mean error, 0·9 per cent, equal to the calculated most probable error due to uncertainty of readings) indicates a remarkable homogeneity of specific ionization of the different components of cosmic radiation (primary and secondary).

MAX G. E. COSYNS.

Physical Laboratory,
"Fondation Médicale Reine Elisabeth",
Brussels. July 21.

[1] *Phys. Rev.*, 49, 854 (June 1936).
[2] *Berl. Ber.*, 830 (1931).
[3] Cosyns et de Bruyn, *Bull. Ac. Belg.*, 20, 371 (1934).
[4] Tuwim und Kolhörster, *Z. Phys.*, 73, 130 (1931).

## Diffraction of Light by Ultra-Sonic Waves

IN a recent paper, R. Lucas[1] has described an experiment designed to test the relative merits of a theory, proposed by C. V. Raman and N. S. Nagendra Nath, of the scattering of light by high-frequency sound waves and that due to himself and P. Biquard. The two theories differ in that, while Raman and Nath assume only a change in phase of normally incident light as it progresses through the sound field, Lucas and Biquard's theory takes account of changes in both amplitude and phase. Lucas's experiment appears to prove by indirect methods that the theory of Raman and Nath is true only for sound fields of thicknesses of the order of 4 mm. or less. R. Bär[2] has also reported on an experiment which indicates that while the Raman-Nath theory predicts a type of intensity distribution which agrees qualitatively with the observed patterns at frequencies of 1·5 and 7·5 megacycles, there are several discrepancies which indicate that the fundamental assumption of these authors is incorrect. The portion of their theory dealing with oblique incidence apparently gives results which are not in accord with the observations, particularly at the higher frequency. Furthermore, Bär has obtained 'photographs' of the actual ultra-sonic grating by the insertion of a photographic plate in an appropriate position in the light beam behind the stationary sound field. With no lens system of any type to focus the light rays, a series of quite sharp fringes appears on the plate, indicating the presence of some changes in light amplitude as well as in phase.

I have recently completed some experiments, which are to be published shortly in the *Canadian Journal of Research*, in which the distribution of light energy among the various diffraction orders has been measured as a function of ultra-sonic intensity at a number of frequencies in the region of 5 megacycles per second. Using light of wave-length 589 mμ, path lengths of about 2·5 cm. and ultra-sonic intensities ranging from zero to about 0·2 watts per cm.$^2$, it is found that the envelopes of the diffraction patterns as predicted by the Raman–Nath theory are in excellent agreement with the observations for light scattered in both progressive and standing wave fields, the intensities of positive and negative orders from zero to five being measured.

In view of this close agreement, it appears somewhat strange that further experimental evidence should indicate the fundamental assumption of Raman and Nath to be in error. The explanation may possibly be found in the deviations of a practical sound field from the ideal case postulated by those authors, who for simplicity assume the sound field to consist of a rectangular prism of plane waves, the sound intensity over any plane normal to the direction of motion of the waves being constant at any instant. A light ray incident normally on such a field would suffer retardations in phase only. In the practical case, however, the sound field does not fulfil these conditions, particularly at the edges. It is probable that a light ray incident in a direction normal to the axis of the field may suffer some refraction on entering the sound field. Once bent, the ray will be traversing layers of varying refractive index and will suffer some changes in amplitude. Eventually, the various rays may come to a series of foci, thus producing the fringes observed by Bär. In such a field the Raman–Nath theory for oblique incidence might also fail, as noted by Bär.

The fact that the discrepancies between theory and observation are less at the lower frequencies tends to support the above hypothesis since, as the sound wave-length is increased, the probability of a light ray entering the field under the conditions postulated by Raman and Nath is considerably greater. In the case of normal incidence, it is quite conceivable that small changes in amplitude, coupled with the normal changes in phase, give rise to an emergent light wave surface which approximates very closely to that which would be produced if changes in phase alone had occurred. That this is the case appears to be substantiated by the very close agreement between the predicted intensities in the various orders and those measured quantitatively by me and observed qualitatively by Bär.

Until a theory is developed which takes complete account of the nature of a practical sound field, it would hence appear that the theory of Raman and Nath, though based on an assumption which is somewhat erroneous in the practical case, describes most accurately the nature of the diffraction effects observed.

F. H. SANDERS.

National Research Laboratories,
Ottawa.
July 11.

[1] R. Lucas, *C.R.*, **202**, 1165 (March 30, 1936).
[2] R. Bär, *Helv. Phys. Acta*, **9**, 265 (1936).

## Absorption Spectrum of Heavy Methane ($CH_3D$) in the Photographic Infra-Red

WE have recently prepared 40 litres of monodeuteromethane and examined its absorption spectrum in the photographic infra-red from 12,000 A. to 6000 A. under the high dispersion of a grating spectrograph. Examination of our plates reveals complete absence of even the strongest lines of ordinary methane; absence of the heavier methanes was shown by density determinations carried out on a specially fractionated sample.

The spectrum includes a region of intense absorption extending from 8350 cm.$^{-1}$ to 9000 cm.$^{-1}$ with a particularly strong and broad maximum at 8617 cm.$^{-1}$. The structure here is complex, but if anything simpler than with ordinary methane, although no obvious regularities stand out. Of particular interest is the occurrence at 9065 cm.$^{-1}$ of a band with a simple structure of regularly spaced lines (approximate spacing 7·5 cm.$^{-1}$) and with what may be a $Q$ branch at 9021 cm.$^{-1}$. In the case of methane[1], a similar band is found at 9047 cm.$^{-1}$ with a spacing of 10·5 cm.$^{-1}$, and apparently similar bands are also shown by methyl halides[2] round about 9025 cm.$^{-1}$. The region from 9600 cm.$^{-1}$ to 10,200 cm.$^{-1}$ is occupied by some ten fainter bands. Then from 10,960 cm.$^{-1}$ to 11,220 cm.$^{-1}$ come four bands, that at 11,220 cm.$^{-1}$ being relatively strong and very similar in appearance to the methane band of the same frequency.

A detailed discussion of this spectrum will shortly be published elsewhere.

W. H. J. CHILDS.
H. A. JAHN.

Davy Faraday Laboratory,
Royal Institution,
London, W.1.
July 22.

[1] W. H. J. Childs, *Proc. Roy. Soc.*, A, **153**, 555 (1936).
[2] H. Verleger, *Z. Phys.*, **98**, 342 (1936).

## The Cepheid Variables and Black-Body Radiation

IN dealing with the problem of determining the concurrent variations in radius and temperature in the Cepheid variables, in order, for example, to construct the *Milne diagram*[1] *for the variability*, two possible alternative points of view may be considered, each being inconsistent with the other.

(1) The radial velocities, determined from the displacement of the absorption lines in the spectrum, can be taken to represent unchanged the radial motion of the photosphere. In this case the pulsation theory in its present form has to be abandoned, and it is further necessary to assume that the Cepheid radiation deviates very markedly from that of a black body. These are the postulates favoured by Getting[2], who has in this way prepared Milne diagrams for a number of Cepheids.

(2) We may assume the radiation to approximate closely to that of a black body, and consider the radial velocities to give a measure of the motion of the atmospheric layers only. The radius of the photosphere at any phase must then be considered as completely unknown; the temperature and radius can, however, be determined by the application of the Planck radiation formula, from magnitude determinations in light of two different wave-lengths.

At the present stage of our knowledge, it appears doubtful, however, whether we can assume, a priori, that the velocity of the atmospheric layers reflects the motion of the photosphere. It is known that the radial velocity curve differs for lines at different levels in the atmosphere, both with regard to phase and to amplitude. It is difficult to decide which level is to be taken as representing the motion of the photosphere.

Further, we are at present unable to give a satisfactory picture of the chromosphere in a static star. It follows therefore that the problem of the pulsations of an extended atmosphere in which the photospheric temperature and surface gravity are both undergoing considerable variations is very far from solution; in fact, until some attempt has been made to predict the behaviour of such an atmosphere, it appears advisable not to use the radial velocities to determine the motion of the stellar body.

If (1) fails, we are forced to investigate the possibility that the Cepheids radiate as black bodies. A recent investigation by Kox[3], with this object, has led to the conclusion that this is definitely not the case. Kox has, however, made the initial assumption that the radial velocities give the stellar motion, which is inconsistent with the possibility of black-body radiation, so that his conclusion is not unexpected, and must be regarded as invalid. If, in conformity with (2) above, we assume the radius at any phase to be completely unknown, Kox's observations of the amplitude of light variation in two regions of different wave-length enable us to calculate maximum and minimum temperatures and radii, but are incapable of providing a test of the agreement of the stellar radiation with that demanded by the Planck formula.

It is obvious, however, that if the amplitude of light variation could be determined in three or more wave-lengths, the maximum and minimum temperatures and radii could be calculated from the results of any two such determinations. If the Planck formula is satisfied, the remaining observations should all be consistent with these results.

Kox gives material for $\delta$ Cephei from other investigations which enable us to test this conclusion. It is found that if all observed amplitudes are corrected by the same term, depending on the maximum and minimum radii, determined from two observations, the temperature range $\Delta T$ required to produce the corrected variation in light is 1,810°. The probable error of a single $\Delta T$ is 30°, which would be produced by an error of approximately 0·015 mag. in the observed amplitude, and can, therefore, be explained entirely by errors of observation.

On the present data, the conclusion therefore is that the light variation in the Cepheids is consistent with the joint assumptions:

(*a*) The stars radiate to a close approximation as black bodies.

(*b*) The photospheric radius is considerably greater at minimum light than at maximum, that is, the radial velocities are not to be regarded as reflecting unchanged the motion of the photosphere.

A. E. H. BLEKSLEY.
University of Witwatersrand,
Johannesburg.
June 26.

[1] E. A. Milne, *Mon. Not. Roy. Ast. Soc.*, **94**, 418 (1934).
[2] Getting, ibid., **95**, 139 (1934).
[3] Kox, *Astr. Nach.*, **256**, 21 (1935).

## Thermal Conductivity of Deuterium

IN the course of an experimental investigation of thermal conduction in deuterium-hydrogen mixtures, recently completed, determinations of the absolute value of the thermal conductivity of deuterium have been made. The method used in these determinations was the hot wire method as developed by Gregory and Archer[1,2].

The deuterium was prepared from deuterium oxide of guaranteed 99·95 per cent concentration, supplied by Imperial Chemical Industries, Ltd., and two independent methods of preparation were adopted:

(1) The vapour of the deuterium oxide was passed over pure magnesium, heated by means of an electric furnace to about 500° C. in a quartz tube, after very careful and prolonged de-gassing of the magnesium. In this instance, the value of the thermal conductivity of deuterium at 0° C. obtained from the measurements was

$$0{\cdot}000308_2 \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1} \text{ C.}$$

(2) The deuterium was prepared by decomposition of the oxide by metallic sodium, the sodium having been previously boiled *in vacuo* to remove all traces of air and other impurities. In this case, the value of the thermal conductivity of deuterium at 0° C. found was

$$0{\cdot}000307_8 \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1} \text{ C.}$$

In both cases, the observations were checked by repetition of the preparations, using different samples of the deuterium oxide. Also, the same apparatus was used to determine the thermal conductivity of pure hydrogen, prepared by the magnesium method from pure water. The value at 0° C. was found to be

$$0{\cdot}000418_1 \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1} \text{ C.}$$

The accuracy of all the results is estimated to be of the order of 0·25 per cent.

It is of interest to note that the value for deuterium obtained by calculation[3] from the experimental value for hydrogen is

$$0{\cdot}000295_7 \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1} \text{ C.,}$$

while the actual measurements of Kannuluik[4] gave

$0{\cdot}000329_4$ cal. cm.$^{-1}$ sec.$^{-1}$ deg.$^{-1}$ C.

A detailed account of the investigations will be published elsewhere in the near future.

CHARLES T. ARCHER.
Imperial College of Science and Technology,
South Kensington, London, S.W.7.
July 22.

[1] Gregory and Archer, *Proc. Roy. Soc.*, A, **110**, 91 (1926).
[2] Gregory and Archer, *Phil. Mag.* (7), **15**, 301 (1933).
[3] "Ortho-, Para- and Heavy Hydrogen", Farkas A., p. 148.
[4] Kannuluik, NATURE, **137**, 741 (1936).

## Effects of Hypertonic Media on the Contractile Vacuoles of Protozoa

IT has long been suspected that the contractile vacuoles of Protozoa maintain the internal osmotic pressure of the organism above that of the external medium, and it has been argued that, if this is correct, the rate of vacuolar output should be reduced when the external osmotic pressure is raised. This has been found to be true for various Ciliata, and recent work has made it necessary to examine evidence of this nature more critically.

In Peritrich Ciliates[1] and in *Paramecium*[2], it has been found that if the external osmotic pressure is raised sufficiently the body shrinks, but that the contractile vacuole may continue to eject water, although at a reduced rate, even after this shrinkage. Kamada[2] has argued from his results with *Paramecium* that since the body has shrunk, the internal osmotic pressure is no longer above the external osmotic pressure, and hence that no more water can be entering through the body surface, and therefore in turn that the water ejected by the contractile vacuole must be of internal and metabolic origin. This argument is open to criticism.

According to the osmotic control theory, the contractile vacuole acts as a pump which, by utilizing energy, ejects water and retains the salts of the organism. There is no reason whatsoever why the contractile vacuole should stop as soon as the external osmotic pressure is raised so as to equal or exceed the (original) internal osmotic pressure of the organism. Its continuance would lead to a raising of the internal osmotic pressure by a shrinkage of the body until a new and steady value was attained above that of the new external medium. One might, however, expect a decrease in rate of output owing to the increased energy required to separate water from a more concentrated internal solution. Only if the external osmotic pressure were raised very considerably above the original internal osmotic pressure of the organism would one necessarily expect the contractile vacuole to stop completely.

After an increase in the osmotic pressure of the external medium, in the process of reaching a new steady state (1) the body will shrink, and the internal osmotic pressure will therefore be raised, with the result that (2) the rate of vacuolar output will (probably) decrease, and (3) the rate of entry of water by osmosis through the body surface will increase (even from zero or from a negative value). The body volume will become constant when it has decreased to such a value that the rates of loss (2) and gain (3) of water are equal. There is no reason for expecting a linear relationship between rate of vacuolar output and external osmotic pressure. The rate of vacuolar output will be dependent on unknown internal factors such as the water content or salt concentration of the tissues. This theory is in good accordance with the data which are available for Ciliata.

The situation is more complicated for *Amœba*, and the evidence is more conflicting, although a similar explanation may be applicable. Adolph[3] found that the contractile vacuole of *Amœba proteus* maintained its rate of output undiminished when the organism was subjected to pure solutions of sodium chloride or other salts up to $M/20$ in concentration (that is, of osmotic pressure equal to about one-tenth of that of sea water). But Zuelzer[4] found that fresh-water amœbæ lost their contractile vacuoles when transferred to sea water, and Hogue[5] found that marine amœbæ developed contractile vacuoles when cultured on an agar medium made up with fresh-water.

It seems therefore probable that Adolph did not use strong enough solutions, and in any event pure sodium chloride is scarcely a suitable medium for the purpose. It may be stated in conclusion that the situation as regards amœbæ is still unsettled, but that the evidence so far available is not inconsistent with the osmotic control theory of the contractile vacuole.

J. A. KITCHING.
Birkbeck College,
London.

[1] Kitching, J. A., *J. Exp. Biol.*, **11**, 364 (1934).
[2] Kamada, T., *J. Sci. Tokyo Imp. Univ.*, **4**, 49 (1935).
[3] Adolph, E. F., *J. Exp. Zool.*, **44**, 355 (1926).
[4] Zuelzer, M., *Archiv EntwickMech.*, **29**, 632 (1910).
[5] Hogue, M. J., *J. Elisha Mitchel Sci. Soc.*, **39**, 49 (1923).

## Colloid Osmotic Pressure of the Body Fluids of Freshwater Animals

THE fact that the colloid osmotic pressures exerted by the body fluids of marine animals arrange themselves in the order of their phylogenetic development[1], suggested that there exists a definite relationship between the general organization of an animal and the colloid osmotic pressure of its body fluids. The results of the measurements undertaken with the hæmolymphs of some terrestrial invertebrates confirmed this hypothesis; the values obtained[2] were indeed practically the same as those of the body fluids of the corresponding marine animals. I concluded from these observations that neither sea water nor air as surrounding media have any marked influence on the above-mentioned relation.

It was interesting to see whether this relationship is modified by life in fresh-water. I have therefore measured the colloid osmotic pressures of the body fluids of some freshwater animals and compared the results with the data previously found for the corresponding marine groups. The animals used were one species of lamellibranch Molluscs (*Anodonta cellensis*), two species of gasteropod Molluscs (*Limnœa stagnalis*, *L. auricularis*), one decapod Crustacean (*Astacus fluviatilis*), and three teleostean fishes[3] (*Cyprinus carpio*, *Esox lussius*, *Anguilla vulgaris*). The following table gives the average values of each of these groups (except the values obtained with the serum of the eel, which will be discussed below) and, for comparison, the average values of the corresponding marine animals:

| | Marine animals (cm. $H_2O$) | Freshwater animals (cm. $H_2O$) |
|---|---|---|
| Lamellibranch molluscs | 1·1 | 0·8 |
| Gasteropod molluscs | 1·5 | 1·2 |
| Decapod crustaceans | 3·6 | 3·1 |
| Teleostean fishes | 19·0 | 11·9 |

The table shows that the colloid osmotic pressures of the body fluids of freshwater animals arrange themselves, as well as those of the marine animals, in the order of phylogenetic development. The parallelism between the two series of figures is striking. There is, however, a marked difference between the marine animals and those living in fresh-water: the values for the freshwater animals are 20–35 per cent lower than those given by the body fluids of the marine animals. This difference does not conflict with the hypothesis of a relation between the general organization of an animal and the colloid osmotic pressure of its body fluids, but even strengthens it. The freshwater fauna being considered as a regressive branch of the aquatic fauna in general, this regression expresses itself by a diminution of the colloid osmotic pressure of the body fluids of these animals.

There is one exception from this rule: the eel's serum exerts a colloid osmotic pressure varying from 19·9 to 27·2 cm. $H_2O$. This exception, however, does not in the least weaken the hypothesis; though passing a great part of its life in fresh-water, the eel must essentially be considered as a marine fish. The colloid osmotic pressure of its serum has indeed the same value as that of one of the most active marine Teleosteans, that is, *Labrax lupus*.

PAUL MEYER.

Laboratoires Lumière and
Laboratoire de Physiologie générale
de la Faculté des Sciences,
Lyon.
July 21.

[1] P. Meyer, NATURE, 136, 757 (1935); *Compt. rend. Soc. Biol.*, 120, 303, 305 (1935); *J. Physiol.*, 84, 5 (1936).
[2] P. Meyer, NATURE, 137, 401 (1936); *Compt. rend. Soc. Biol.*, 120, 1004, 1005 (1935); *J. Physiol.*, 84, 448 (1936).
[3] A. Keys and R. M. Hill (*J. Exper. Biol.*, 11, 28; 1934) had already measured the colloid osmotic pressure of the serum of three freshwater teleosteans (*Tinca vulgaris*, *Esox lucius* and *Anguilla vulgaris*). The figures reported by these authors agree with the values recorded in this note.

## Metabolism of Cartilage

IN reply to the letter of Dickens and Weil-Malherbe[1], a previous communication[2] on this subject was based, except where rabbit cartilage was specified, on more than one hundred experiments with cartilage from the carpo-metacarpal joints of the adult horse, to whose metabolism that of human cartilage is very similar.

As regards the rabbit, hyaline cartilage from the femur has an anaerobic glycolysis of 1·0 for the first few hours, falling to an average of 0·6 over the 24 hours: the figures cited previously refer to meniscus (fibrocartilage) over a period of 24 hours in an experiment lasting fourteen days. A comparable figure is that for the first hour, 0·6.

Respiration measurements have not yet been made on rabbit material, but it is perhaps of interest:

(1) That the well vascularized epiphyseal cartilage of the fœtal rabbit has an anaerobic glycolysis ten times as high as the adult, or, per cell, twice as high.

(2) That a human enchondroma showed a glycolysis thirty times that of normal cartilage and an oxygen uptake of 0·34.

E. G. L. BYWATERS.

Courtauld Institute of Biochemistry,
Middlesex Hospital Medical School,
London, W.1.
July 25.

[1] Dickens and Weil-Malherbe, NATURE, 138, 125 (1936).
[2] Bywaters, NATURE, 138, 30 (1936).

## Intermediate Metabolism of Carbohydrates

WE have found some new chemical reactions in living cells which represent steps in the breakdown of carbohydrates. Pyruvic acid, if added to animal tissues, disappears rapidly not only in the presence, but also in the absence of oxygen. In the presence of oxygen the end-products of the pyruvic acid metabolism are known to be carbon dioxide and water. We find that the primary steps of the oxidation proceed in the absence of molecular oxygen, and as products of the anaerobic oxidation the following substances were identified: (1) acetic acid, (2) carbon dioxide, (3) succinic acid.

The reductive equivalent for the oxidation of pyruvic acid is the conversion of another fraction of pyruvic acid into lactic acid or the homologous reduction of another ketonic acid. The quantitative data suggest that pyruvic acid is metabolized by the following intermolecular oxido-reductions: The first step is a dismutation of pyruvic acid according to the reaction:

(1) 2 pyruvic acid + water → acetic acid + carbon dioxide + lactic acid.

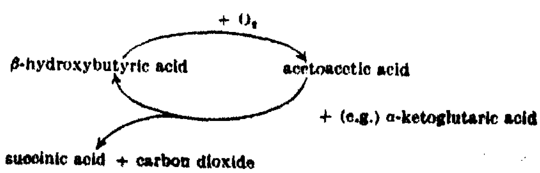
The evidence for the occurrence of this reaction in the tissues which metabolize carbohydrates is conclusive. The subsequent reactions which lead to the formation of succinic acid may be tentatively formulated in the following way:

(2) acetic acid + pyruvic acid + 'ketonic acid' → α-ketoglutaric acid + 'hydroxy acid'.

(3) α-ketoglutaric acid + 'ketonic acid' + water → succinic acid + carbon dioxide + 'hydroxy acid'.

According to (2) α-ketoglutaric acid is formed by the oxidative condensation of pyruvic and acetic acids, a ketonic acid acting as hydrogen acceptor. According to (3), α-ketoglutaric acid is oxidatively decarboxylated by dismutation. Reaction (3) is analogous to (1).

The experiments suggest that different 'ketonic acids', such as pyruvic acid, acetoacetic acid, oxalacetic acid[1], or their homologues may be concerned in reactions (2) and (3), and may possibly take the place of pyruvic acid in (1). It seems that acetoacetic acid reacts preferentially in (3), and it is therefore of great interest that we find in tissues which metabolize carbohydrates a specific system which catalyzes the oxidation of β-hydroxybutyric to acetoacetic acid by molecular oxygen[2]; β-hydroxybutyric acid may thus act as a carrier for molecular oxygen according to the scheme (4).

(4)



As is indicated in (4), α-ketoglutaric acid is not directly oxidized by molecular oxygen, but through the intermediation of another ketonic acid. It has long been known that there are links between carbohydrate breakdown and 'ketone bodies', and it is now possible to describe this link, or at least one of the links, in chemical terms.

The oxidative formation of succinic acid from pyruvic acid has been discussed by previous workers.

The new feature is the demonstration that this oxidation is brought about by anærobic oxido-reductions. The reactions described seem to occur in all animal tissues which metabolize carbohydrates. They occur also in bacteria. Reaction (1), for example, is quantitatively realized in gonococci.

The work of Peters[3] and the findings of Simola[4] suggest that vitamin $B_1$ is a co-enzyme for dismutations of the type of the reactions (1) and (3). Experiments on tissues of vitamin $B_1$ deficient rats and chickens show that such is the case.

H. A. KREBS.

Department of Pharmacology,
University, Sheffield.
July 9.

[1] See also A. Szent-Györgyi, *Z. physiol. Chem.*, **236**, 1 (1935).
[2] See also M. Jowett and J. H. Quastel, *Biochem. J.*, **25**, 2181 (1935).
[3] R. A. Peters, *Lancet*, May 23, 1936.
[4] P. E. Simola, *Suomen Kem.*, **9**, B, 4 (1936).

## Length of Saccharide Chains in Glycogens from Different Sources

EMPLOYING Haworth's 'end-group assay' method, it has already been shown that rabbit liver glycogen formed under normal conditions has a chemical molecule built up of a chain of 12 glucose units[1,2]. Fish (Gadidae) liver glycogen also conforms to this structure[2].

Haworth afterwards recorded that glycogen (source not mentioned) may also exist derived from 18 units[3].

I have now examined, by the above method, the glycogens (*a*) laid down in the liver after oral administration of galactose to fasted rabbits; and (*b*) from the whole tissue of *Mytilus edulis*. In each instance the mean number of glucose units in the chemical molecule of the polysaccharide has been found to be 18.

This fact was revealed only following examination of the cleavage products of the methylated glycogen in question. No apparently significant differences from 12 unit glycogen could be demonstrated by examination of the purified polysaccharides themselves with respect to $[\alpha]_D$, reducing power, rate of hydrolysis, or properties of the acetylated or methylated derivatives.

These investigations will be fully reported through the usual channels.

DAVID JAMES BELL.

Biochemical Laboratory,
Cambridge.

[1] Haworth and Percival, *J. Chem. Soc.*, 2277 (1932).
[2] Bell, NATURE, **136**, 184 (1935); *Biochem. J.*, **29**, 2031 (1935).
[3] Haworth, Pres. Add. to Chem. Soc. of Brit. Ass., p. 41 (1935).

## Inhibitory Effect of Phloridzin and Phloretin on Kidney Phosphatase

THE inhibitory effect of phloridzin on phosphatase action[1] is well pronounced only when rather high concentrations (about $m/50$–$m/100$) of the poison are used. The phloridzin concentrations which are able to prevent any reabsorption of glucose in the kidney are definitely lower[2] (about 0·5–1 mgm. per gm. kidney). Phloridzin is hydrolyzed by $N$ hydrochloric acid at 100° into glucose and phloretin.

The present communication shows that the inhibitory effect of phloretin on kidney phosphatase is about three to four times as high as that of phloridzin. In alkali at 100° the phloridzin is hydrolyzed into phloroglucin-glucoside and phloretin acid. Here also an increase in the poisonous action (about twice) is observed. Phloroglucin has no poisonous action on phosphatase; pure phloroglucin-glucoside has not been tested. However, phloroglucin-glucoside inactivates the reabsorption of glucose in the kidney[3].

*Exp.* 24/6. Kidney phosphatase; veronal buffer *p*H 8·5; temp. 38° C.; incubation, 60 min.

| Substrate: glycerophosphate | Ester hydrolysis (mgm. P) | Per cent inhibition |
|---|---|---|
| Normal sample | 0·350 | |
| Phloridzin $m/370$ | 0·292 | 15 |
| Phloretin $m/370$ | 0·152 | 57 |

In this connexion, it is of interest that liver and kidney contain great amounts of β-glycosidases; phloridzin-glycosidase has been found in horse kidney[4].

H. KALCKAR.

University Institute
of Medical Physiology,
Copenhagen.
July 10.

[1] Lundsgaard, *Biochem. Z.*, **264**, 209 (1933).
[2] Lundsgaard, *Skand. Arch. Physiol.*, **72**, 265 (1935).
[3] Lambrechts, *Compt. rend. Soc. biol.*, **121**, 870 (1936).
[4] Hoffmann, *Biochem. Z.*, **285**, 429 (1936).

## Steady Performance of Geiger-Müller Counters

DUE to rapid discharges that take place in a counter, a considerable amount of gas may easily be liberated, or in some cases even adsorbed, causing fluctuations of pressures in the counters. After working for some time, the voltage initially found to be suitable may no longer be so, and may lie beyond the limits within which the counts are independent of variations of applied voltage. This is more likely to occur with low-pressure counters than with high-pressure ones, since the working range of voltage diminishes with diminution of pressure. Herein lies the cause of unsteadiness.

One way of remedying this unsteadiness is to increase the pressure in the counter; but this necessitates the use of very high voltages to the counter. Two other ways are open. By the use of suitably high resistances between the counter and the battery, the tendency for a heavy arcing discharge to be initiated by the condenser discharge can be checked. Another way is to use a big reservoir in connexion with the counter volume. The large volume makes changes of pressure negligible.

We have found that counters in which no counting range could be detected easily gave such ranges on the insertion of a ten-litre volume. This arrangement was tested for pressures from 5 mm. up to 10 cm. with counters of different dimensions, air being used in all cases. Tinned copper wire of about 0·3 mm. diameter was used for the central electrode. The tinning was done not for any special reason, it being the usual 5 amp. fuse wire. The material of the outer electrode is brass, in thin sheet and enclosed in a sealed glass tube.

B. DASANNACHARYA.
G. S. RAO.
Department of Physics,
Benares Hindu University.

## Vibrational Frequencies of Molecules

IN a recent letter to NATURE[1], I submitted evidence that the ground state vibrational frequency of a molecule $AB$ was the mean of the frequencies of the molecules $A_2$ and $B_2$ provided that $A$ and $B$ belong to the same group of the Periodic Table. I was then unaware of the work of Dr. C. H. Douglas Clark[2], who had previously arrived at the same conclusion. To account for certain deviations from this rule, he adds the further condition that the frequencies of $A_2$ and $B_2$ must not be too dissimilar in magnitude.

If the motion of a diatomic molecule $AB$ be considered simple harmonic, the vibrational frequency $\omega$ is given by the expression:

$$\omega = \frac{1}{2\pi}\sqrt{\frac{M_A + M_B}{M_A \, . \, M_B} . K},$$

where $M_A$ and $M_B$ are the atomic weights of $A$ and $B$ respectively and $K$ is the force constant. It is reasonable to assume in the first instance that for such molecules as $A_2$, $B_2$ and $AB$, the force constant $K$ will have the same value. A simple calculation then shows that the above relation between the vibrational frequencies follows if the masses $M_A$ and $M_B$ are of the same order. Consequently the frequencies of $A_2$ and $B_2$ should also be of the same order, thus accounting for Clark's second condition.

H. G. HOWELL.

Armstrong College,
Newcastle-on-Tyne.

[1] H. G. Howell, NATURE, 138, 36 (1936).
[2] C. H. Douglas Clark, *Trans. Faraday Soc.*, 31, 1017 (1935).

## Asymmetry in Metallic Zinc and Cadmium

IN the issue of NATURE of February 22, Dr. G. W. Brindley reports on discrepancies in the X-ray scattering factors of zinc and cadmium. The observed values do not lie on a smooth curve. Of the two possible interpretations of this phenomenon, namely (*a*) the asymmetry of the atom or (*b*) the asymmetry in the lattice vibrations, Dr. Brindley gives preference to the latter, since the deviations are too large to be explained by (*a*)[1].

Nevertheless, I wish to say that the possibility of an appreciable variation from a spherical shape of the zinc and cadmium atoms is not altogether out of the question. This opinion is based on the two following observations:

(1) Nineteen of the twenty-one elements having the close-packed hexagonal structure[2] show a ratio $c/a$ between $1{\cdot}578_5$ (Os) and $1{\cdot}64$ (Ni). This implies variations of only $-3{\cdot}3$ per cent and $+0{\cdot}43$ per cent respectively from the value $1{\cdot}633$, which corresponds to the case of close-packed spheres. Cadmium and zinc, however, show values of $1{\cdot}885_9$ and $1{\cdot}856_3$ ($1{\cdot}884_2$ resp. at 415°), these ratios being $15\frac{1}{2}$ per cent higher. This difference seems to be too large to be explained by thermal oscillations, should this be taken as the reason for the deviations in the case of the other metals.

(2) The following calculation seems to be of still greater weight. In pursuance of the hypothesis that cadmium and zinc atoms are rotational ellipsoids[3], the question arises, what would be the shape of the ellipse forming the cross-section, that is, what would be its numerical eccentricity. The answer is given by the following calculation for cadmium ($p$ = major, $q$ = minor axis):

$$\frac{p}{q} = \frac{1}{\sqrt{1-\varepsilon^2}} = \frac{(c/a)_{\text{ellipse}}}{(c/a)_{\text{sphere}}} = \frac{1{\cdot}885_9}{1{\cdot}6333},$$

and hence $\varepsilon = 0{\cdot}5002$; that is, equal to 1/2 as precisely as possible[4]. It is difficult to believe that this is a mere chance, especially in view of the considerations mentioned under (1). (There is no intermediate value between $1{\cdot}64$ and $1{\cdot}856_3$).

The foci of this ellipse are situated at the centre of each half of its major axis. It is therefore possible to put a sphere in each half of the rotational ellipsoid, their centres coinciding with the foci and their surfaces touching the vertices and the centre of the ellipsoid. Such a rotational ellipsoid, being a 'quasi double-sphere', can be regarded as a body very nearly related to the sphere as to its degree of symmetry.

K. HERRMANN.

Technische Hochschule,
Berlin.

[1] See also the paper by C. Zener, *Phys. Rev.*, 49, 122 (1936).
[2] See M. C. Neuburger, "Gitterkonstanten 1936", *Z. Krist.*, 93, 1 (1936).
[3] This view has been mentioned by various writers: Hull, Ewald, Hume-Rothery. See also Canfield, *Phys. Rev.*, 35, 530 (1930).
[4] For zinc at room-temperature with $1{\cdot}856_3$, one gets $\varepsilon = 0{\cdot}475_4$ and at 415° with $1{\cdot}884_2$, $\varepsilon = 0{\cdot}4989$.

THROUGH the kindness of the Editor, I have been allowed to see Prof. Herrmann's letter prior to its publication. I entirely agree that the X-ray results do not exclude the possibility that the *outermost* electrons of the atoms in metallic zinc and cadmium may depart from having spherical symmetry; one would not expect the completed inner electron shells to have appreciable asymmetry. The possibility of the outermost electrons being asymmetrical, however, is not to be regarded as an *alternative* explanation of the experimental results, but as something *additional* to the explanation already given in terms of asymmetrical lattice vibrations. The contributions of the outermost electrons to the scattering factors of zinc and cadmium at all angles for which measurements can be made are so small that one could scarcely hope to measure an asymmetry in their distribution by means of X-rays. On the other hand, any asymmetry in the lattice vibrations will affect the entire atom, and at large scattering angles, measurable effects may be expected if the asymmetry is sufficiently great, and this appears to be so for zinc and cadmium.

With regard to point (1) raised by Prof. Herrmann, it is difficult to see whether this indicates an asymmetry of the atoms or of the lattice vibrations, without going into the matter much more fully. If, however, the unusually high $c/a$ values of zinc and cadmium are associated with strongly asymmetrical lattice vibrations, then one might expect that a 'normal' metal, such as magnesium with $c/a = 1{\cdot}624$, would not show strongly asymmetrical vibrations. I have recently carried out an X-ray investigation of magnesium similar to the previous experiments on zinc and cadmium, and the results so far obtained suggest that in magnesium the lattice vibrations are very much more nearly isotropic than in zinc and cadmium. These results appear to be consistent with the fact that, whereas in zinc and cadmium the thermal expansion coefficients perpendicular and

parallel to the principal axis are very different, in magnesium they are almost the same[1].

With regard to Prof. Herrmann's second point[2], that the eccentricity of the ellipsoidal space occupied by an atom in zinc or cadmium is almost exactly 1/2, and that into this space one can place two spheres in contact with their centres at the foci, it is difficult to see what *physical* significance this *geometrical* result can have ; if one regards the atom as occupying alternately the two foci, the situation is equivalent to a larger vibration along the *c*-axis than normal to it.

Finally, it may be mentioned that since my letter appeared in NATURE, the results for zinc have been discussed in the *Philosophical Magazine*[2], and a preliminary account of the cadmium results has appeared in the *Proceedings of the Leeds Philosophical Society*[3].

G. W. BRINDLEY.

Physics Laboratories,
University, Leeds.
July 13.

[1] See, for example, a recent paper by E. Goens and E. Schmid, *Phys. Z.*, **37**, 385 (1936).
[2] *Phil. Mag.*, **21**, 790 (April 1936).
[3] *Proc. Leeds Phil. Soc.*, **3**, 200 (April 1936).

## Oxide Layer on a Polished Surface

I CAN confirm S. Dobinski's results[1] for copper by my own experiments on polished aluminium[2]. I used a different method, namely, observations of changes in the initial solution potential when polished under paraffin, benzene, water. The conclusion I came to in my paper was that wet "polishing resulted in the formation of an oxide film in close contact with the metal and similar to that formed by heating in air". This seems further evidence that many observations on the so-called 'amorphous' layer may really have been observations on the properties of the oxide.

L. H. CALLENDAR.

16 Sandileigh Avenue,
Withington,
Manchester.

[1] NATURE, **138**, 31, July 4, 1936.
[2] "The Influence of Boundary Films on Corrosive Action", *Proc. Roy. Soc.*, A, **115**, 368 (1927).

## Inhibitive Effect of Vitamin C on Toxin Production by *C. diphtheria*

KING and Menten (1935) have reported that guinea-pigs having a high vitamin C storage are less sensitive to diphtheria toxin than are those having a low vitamin C storage. This observation may be important in relation to the pathogenesis of diphtheria infection. We, therefore, tried to ascertain the effect of vitamin C on toxin production by *C. diphtheria in vitro*.

Experiments have been conducted on the influence of vitamin C in the culture media on the toxicity of culture filtrates of a toxin-producing strain of *C. diphtheria*. A sterile solution of vitamin C was added to the culture medium in concentrations ranging from 0·05 to 0·125 per cent. The flasks containing vitamin as well as corresponding controls were inoculated with *C. diphtheria*, incubated 48 hours at 30° C., and the toxicity of the filtrates tested by intracutaneous injection in guinea pigs.

Vitamin C added to culture media rapidly disappears on incubation at 30° or 37° C. However, if immediately after the vitamin is added the medium is inoculated with *C. diphtheria*, the vitamin disappears more slowly. But most significant is the fact that even small residual amounts of the vitamin (20–40 mgm. per cent) are sufficient to inhibit toxin production.

A series of experiments under a variety of conditions has clearly established the fact that vitamin C added in small amounts to a suitable medium inhibits toxin production. The same strain of *C. diphtheria* produces a potent toxin in the flask without vitamin C, and little or no toxin in the one containing the same medium plus the addition of 0·05 per cent ascorbic acid.

It is suggested that the varying toxic character of a diphtheritic injection may depend as much on the tissue saturation with vitamin C as on the toxigenic properties of the infecting strain. It is also possible that the mildness of diphtheritic infection in subtropical and tropical countries is in some way related to the quantitative differences in the concentration of this vitamin. These questions are being investigated.

I. J. KLIGLER.

Department of Hygiene and Bacteriology,
Hebrew University, Jerusalem.

## Induced Chiasma Formation in Somatic Cells by a Carcinogenic Hydrocarbon

EXPERIMENTS are being done on the effects of methylcholanthrene on mouse fibroblasts cultivated *in vitro*. The tissue is grown by the hanging drop method in a medium containing approximately 0·005 mgm. of the hydrocarbon per c.c. and is subcultivated every 48 hours. After three days' growth, the cultures when fixed in Navashin's fluid and stained with iodine-gentian-violet are found to contain a high percentage of abnormal mitotic figures of various types.

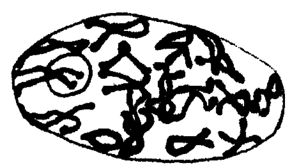


FIG. 1.

Of particular cytological interest is the induction of chromosome pairing and chiasma formation in somatic cells. This condition was observed in several tetraploid cells at various stages from early prophase until anaphase. This disturbance may take the form of a precocity of the prophase in relation to the chromosome splitting, which may also be the underlying mechanism of the induction of chromosome pairing. This suggestion is supported by the abnormal degree of contraction which is observed in the chromosomes both in the cells which show chiasma formation and in the other abnormal cells. The chiasma frequency observed is 1–3 per chromosome as in normal meiosis. A typical prophase cell of this type is shown in the accompanying drawing (Fig. 1) in which some chromosomes have been omitted for clarity.

E. MARIE HEARNE.
(Canadian Federation of University Women's Scholar.)
Strangeways Research Laboratory,
Cambridge.
July 16.

## Isotopes and Molecular Asymmetry

QUITE recently[1], attempts have been made to resolve into their optically active components, molecules of the type C.H.D.$R_1$.$R_2$, with very slight success, if any at all. In 1922[2], I suggested that if this type of asymmetry associated with isotopes was responsible for very slight rotation or none at all, a molecule of the type $C.x.y.R_1.R_2$ should be investigated, $x$ and $y$ being atoms or groups of similar electronic configuration. In view of the resemblance (which some physicists consider is a real one) between the electronic configuration of the methyl radical and the fluorine atom, the molecule of α-fluor-propionic acid might be a fit subject for investigation. This substance may have no optical activity, if the recent results are correct. I am not aware that asymmetric molecules containing $CH_3$ and F as dissimilar groups have ever been subjected to optical resolution.

T. IREDALE.

University,
Sydney.
July 18.

[1] Erlenmeyer and Gartner, *Helv. Chim. Acta*, 19, 145, 331 (1936); Coppock and Partridge, NATURE, 137, 907 (1936).
[2] NATURE, 109, 775 (1922).

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# Points from Foregoing Letters

GRAPHS showing the hourly variations in the (square of the) critical penetration frequency ($f^2$) of radio waves for the $C_1$ ionizing region of the atmosphere, located at a height of 55 km., are given by Dr. H. Rakshit and J. N. Bhar. Prof. Mitra, commenting on one of their remarks, points out that the critical penetrating frequency cannot be taken as a measure of the density of ionization since it depends upon both ionization density and upon collisional frequency, which vary independently.

An experiment conducted by Chas. R. Burrows on the propagation of ultra-short radio waves over fresh water shows that a revision of the Sommerfeld–Rolf curves is required in those cases where the dielectric constant is taken into account.

Max G. E. Cosyns has measured specific ionization of cosmic rays in hydrogen, helium and argon by comparing the efficiency of Geiger-Müller counters for different internal pressures. The results are given for argon, helium and hydrogen. The absolute intensity of cosmic radiation at Brussels has been found to be 0·0266 per second per sq. cm.

Forty litres of methane with a single substituted deuterium atom have been made by Drs. W. H. J. Childs and H. A. Jahn, in order to obtain its absorption spectrum in the photographic infra-red. Preliminary results are given and the spectrum compared with that of ordinary methane.

From data obtained by Kox on the amplitude of light variation of three separate wave-lengths in different regions of a pulsating star (δ Cephei), and assuming that Planck's formula for 'black body' radiation holds in such cases, A. E. H. Bleksley concludes that the light variations in cepheid variables is consistent with the view that the radius of their photosphere (layer from which comes most of the light that reaches us directly, that is, without absorption and re-emission) is considerably greater at minimum than at maximum luminosity.

In discussing the osmotic function of the contractile vacuoles of Protozoa, Dr. J. A. Kitching points out that while one might expect the rate of vacuolar output to decrease after the external osmotic pressure has been raised above the original internal osmotic pressure of the organism, one would not necessarily expect the contractile vacuole to stop completely. Changes of body volume, and hence of internal osmotic pressure, must also be taken into account.

According to Dr. P. Meyer, the colloid osmotic pressures of the body fluids of freshwater animals are in the order of phylogenetic development, but 20–35 per cent lower than those exerted by the body fluids of the corresponding marine animals. Regarding the freshwater fauna as a regressive branch of the aquatic fauna in general, this is not necessarily contrary to the hypothesis of a relation between the general organization of an animal and the colloid osmotic pressure of its body fluids.

Dr. H. A. Krebs describes chemical changes which pyruvic acid undergoes in living cells. These reactions are intermediate steps in the biological breakdown of carbohydrates; they shed light on the relations between the metabolism of carbohydrates and of ketone bodies, and on the physiological function of vitamin $B_1$.

D. J. Bell states that glycogen obtained from the whole tissue of the edible mussel, and also from the liver of fasted rabbits (after oral administration of galactose) consists of 18 glucose units, while the glycogen obtained from the liver of rabbits under normal conditions, or that from fish liver, consists of 12 glucose units. No significant difference in the properties of the two glycogens has been observed.

The action of the phosphatase enzyme of the kidney (which splits phosphoric acid esters) is found by Dr. H. Kalckar to be much more strongly inhibited by phloretin than by its glucoside, phloridzin, a bitter principle in the bark of apple and other trees.

It has been found that the vibrational frequency of a molecule $AB$ is the mean of the frequencies of the molecules $A_2$ and $B_2$ when $A$ and $B$ belong to the same Periodic Group and where the frequencies of $A$ and $B$ are not too dissimilar. Dr. H. G. Howell points out that this result follows if the force constant is considered to be the same for molecules within a given group.

Prof. K. Herrmann prefers to ascribe certain discrepancies in the X-ray scattering factors of zinc and of cadmium to the asymmetry of the atoms rather than to lattice vibrations, and gives reasons for his preference. Dr. G. W. Brindley, in reply, maintains his opinion that the lattice vibrations are responsible for the asymmetry and considers that, while the outermost electrons of the zinc and cadmium atoms may depart from spherical symmetry, the inner complete electron shells are not likely to do so.

# Research Items

### Cultural Associations of Solo Man

DR. P. VAN STEIN CALLENFELS has directed attention (*L'Anthropologie*, 46, 3–4) to the character of certain of the artefacts associated with the skulls of Solo man, when these were found in the alluvial gravels of the River Solo at Ngandong, Java, which apparently are of later date than the gravels of Trinil, from which *Pithecanthropus* was derived. The artefacts were scattered over an adjacent area of about fifty metres. They consisted of worked stones of an indeterminate character, and a number of implements of bone and staghorn (chiefly *Cervus Lydekkeri*) with a quantity of bones, for the most part broken. Their contemporaneity with Ngandong man, it would seem, cannot be questioned. They are now in the Bandoeng Geological Museum of Batavia. A flat harpoon with bilateral barbs would be sufficient alone to justify a comparison with the late Azilian harpoons of Scotland, while certain rare forms of Maglemosian harpoon would also serve for comparison. Even more surprising, however, is the association at Ngandong of these archaic skulls with axes of staghorn, of which analogies can be found only in the Mesolithic. The most ancient reindeer horn axes known have been found in northern Europe and belong to the civilization of Lyngby, the first stage of Childe's Forest Culture. At Ngandong the stem of the horn forms the handle and one of the tines forms the blade of the axe. The Lyngby culture belongs to the pre-Boreal post-glacial, and is a little later than Azilian, say 7000–8000 B.C. While all reserve must be shown in comparing two cultures so far removed from one another as that of Ngandong in Java and the Lyngby culture of northern Europe, in estimating the age of Solo man at Ngandong, the associations of artefacts of similar type in Europe must not be forgotten.

### Tibetan Blood Groups

PROF. R. RUGGLES GATES, in studying blood-groups of American Indians, has been led to seek an Asiatic people of similar physiognomy, who might be sufficiently high in the $O$ blood-group to have been ancestral to the Indians. One such people, whose blood-groups are wholly unknown, are the Tibetans. Material was obtained through Capt. David Tennant, I.M.S., stationed at Gyantse, Tibet, and the results of its examination are recorded by Prof. Ruggles Gates in *Man* of July. The results, both unexpected and unusual, are as follows: $O$, 28, 14·9 per cent; $A$, 88, 47·1 per cent; $B$, 26, 13·9 per cent; $AB$, 45, 24·1 per cent; total, 187. By applying the formula $\sqrt{N}=\sqrt{(A+O)}+\sqrt{(B+O)}-\sqrt{O}$, it is evident that the results do not depart significantly from expectation in a homogeneous or well-mixed population. Of the numerous blood-grouping results listed by Steffan, only one has a higher percentage of $AB$—a series from South Hungary. Some of the Ainu show 25 per cent $AB$, while the Japanese usually run about 10–15 per cent and some Russian communities have about 18–20 per cent $AB$. It is evident that these results, the first to be published from Tibet, show that the Tibetans are at the opposite pole from the Americans. No record from any other race shows such a low percentage of $O$. Another peculiar feature is that $AB$ is nearly double the frequency of $B$. The percentage of $A$ appears to be the highest recorded for Central Asiatic peoples, being definitely higher than the Chinese, and much higher than the Hindoos. A higher percentage of $A$ is found only in peripheral peoples, such as the Lapps, Bushmen or Australian aborigines. The Tibetans are then well saturated with the blood-groups, and the result is such as might be expected from a people originally very high in $A$ meeting a people, such as the Chinese, with a high proportion (c. 35 per cent) of $B$.

### Reindeer Grazing

IN relation to the pastoral possibilities of the North-West Territories of Canada, some conclusions drawn by Mr. E. Porsild, who has spent several years in charge of experimental herds of reindeer, are contained in an article in the *Geographical Journal* of July. Apart from lake areas and rocky ground that exclude large areas, the ubiquity of insect pests, notably the mosquito, seems to be the limiting factor. Except in the arctic archipelago and along the sea-coast of the mainland, flies and mosquitoes occur throughout the North-West Territories in such enormous numbers during the short summer that "neither the reindeer nor the hardiest of herders can endure their movements". The only escape from these pests is to move the herds to the sea-coast in June and July. There are no hills of sufficient height to be clear of mosquitoes. However, all the Canadian Eskimo tribes without exception live on the coast, and are thus potential reindeer herders. Mr. Porsild considers that among the areas suitable for reindeer grazing, the best is on the west coast of Hudson Bay. An area east of the Mackenzie delta will support great herds, and is now in use. So far, the introduced Alaskan reindeer seem to be doing well.

### German Copepods

DR. OTTO PESTA has completed his account of the copepods of Germany and adjacent seas ("Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und nach ihrer Lebensweise". By Prof. Dr. Friedrich Dahl and others. Teil 29. Krebstiere oder Crustacea. 1: Ruderfüsser oder Copepoda (4, Monstrilloida; 5, Notodelphyoida; 6, Caligoida; 7, Lernaeoida). Jena: Gustav Fischer. 6 gold marks). This is a specially interesting and important part of the section dealing with the Copepoda as it contains the parasitic and semi-parasitic forms. Of the Monstrillidæ, which are planktonic in the adult state and the larvæ of which inhabit polychætes (or, exceptionally, a mollusc), there are four species recorded here, and of the Notodelphyoida, which are commensals or true parasites in echinoderms, ascidians or *Cephalodiscus*, there are three species recorded. All the rest belong to the Caligoida and Lernæoida, both groups represented by numerous species. This is a most useful summary, and is well up to the standard of the former parts, the whole being an indispensable reference book for all working in these regions.

### Porcine Trypanosomiasis

HOARE has shown by an exhaustive study (*Trans. Roy. Soc. Trop. Medicine and Hygiene*, 29, No. 6; 1936) that *T. simiæ* is the trypanosome responsible for acute trypanosomiasis of the pig—an animal little subject to infection by the pathenogenic trypanosomes of other domestic animals. Contrary to what was originally thought, it is a polymorphic form, which no doubt accounts for the list of aliases under which it has masqueraded. The intermediate host is the tsetse fly, *Glossina morsitans*, and possibly other species, and the reservoir host is the wart-hog. The etiology and epidemiology of the parasite are discussed.

### Varietal Difference in the Potato

THE text of a lecture on "Recent Developments in Connection with the Potato", recently delivered by Dr. T. P. McIntosh before the Royal Caledonian Society, appears in the *Gardeners' Chronicle* of June 6, 13, and 20. Much work relating to the place of origin of the potato was reviewed, and some recent work in Russia suggests that the Peru-Bolivian plateau and south Chile were the two original centres. Dr. McIntosh dealt with his own work on the observation of varietal differences in potatoes, and their detection by chemical means. A test with dilute caustic potash causes the petals, or the flesh of the tuber of some varieties, to turn a vivid canary-yellow. Oxidase tests may also be applied to the tuber for the detection of certain varieties, and the variety Golden Wonder gives an electric-blue fluorescence with ultra-violet light, where other kinds appear red-purple. Characters of tuber sprouts may also be used for diagnostic purposes, and some very interesting colour correlations are set forth. Various experiments on potato breeding are described, and modern work on virus diseases, blight, and other subjects, is reviewed.

### Spray Covering on Apples

A SHORT paper by Messrs. Kermit Groves and James Marshall (*J. Agric. Res.*, 51, No. 12, 1139–1142, Dec. 1935) directs attention to the fact that spray fluids applied to fruit crops are often deposited very unevenly upon the developing fruits. They show that more than a third of the total wash received by an apple fruit may collect round the depressions at the calyx and stem ends, and recommendations for estimating spray covering are set forth involving a degree of accuracy which, however, scarcely seems justified in a problem of this calibre.

### Vapour Pressure of Deuterium Water

IT is known that the vapour pressure of deuterium water is smaller than that of ordinary water and that the difference becomes smaller as the temperature is raised. F. T. Miles and A. W. C. Menzies (*J. Amer. Chem. Soc.*, 58, 1067; 1936) have determined the pressures for deuterium water at temperatures from 20° to 230° C. by a differential tensimetric method. The results could be reproduced only by a five-constant equation: $\log r = -16 \cdot 998671 + 268 \cdot 8426/T + 7 \cdot 4971604 \log T - 9 \cdot 761107 \times 10^{-3} \times T + 4 \cdot 4288 \times 10^{-6} \times T^2$, where $r = p_{D_2O}/p_{H_2O}$. The normal boiling point of $D_2O$ is calculated as $101 \cdot 40° \pm 0 \cdot 016°$. The temperature at which the vapour pressure of the two varieties of water is identical is calculated as 224·3°, which may be within 0·5° of the truth. Values for the excess of the latent heat of evaporation of $D_2O$ over that for $H_2O$ are calculated. They vary from 300 gm.cal. per mol. at 40° C. to 115 at 220° C. The value at 70° agrees with that found by Lewis and Macdonald for measurements between 20° and 90°.

### Exchange Reactions with Isotopes

E. OGAWA (*Bull. Chem. Soc. Japan*, 11, 367, 425, 428; 1936) has described some experiments on the interchange of hydrogen and deuterium in urea, glutamic acid and asparagine and also in carbohydrates, and on the isotopic separation of oxygen, chlorine, bromine and nitrogen by chemical methods. In a further communication to the Editor, he claims to have achieved a separation of nitrogen isotopes by the following method. One kgm. of ammonium chloride (Sample *A*) in 3 litres of water was converted into ammonia (assumed to be $NH_3OH_2$) by the weighed amount of caustic soda. The ammonia was distilled off and the ammonium chloride was decreased to 47·5 gm. (Sample *B*). This was again decreased to 1·34 gm. (Sample *C*). By interaction with silver nitrate the atomic weights of nitrogen in the samples were determined as 14·002 (*A*), 14·023 (*B*) and 14·105 (*C*). Samples *B* and *C* would then contain 1·61 and 10·5 per cent, respectively, of $N^{15}$ and the separation coefficients would be 5·0 and 3·1. The method depends on a theory of the author according to which the element is richer in heavier isotope when it is in the more positively polarized state. The interchange reaction is $N^{14}H_4{}^+Cl^- + N^{15}H_3OH_2 = N^{15}H_4{}^+Cl^- + N^{14}H_3OH_2$.

### Plaster of Paris

IT has generally been assumed that plaster of Paris is the hemihydrate of calcium sulphate, $CaSO_4$, $\frac{1}{2}H_2O$, which on setting takes up water to form gypsum, $CaSO_4, 2H_2O$. Some recent investigations on various lines have been held to show that the water in gypsum is lost on dehydration without any intermediate formation of a lower hydrate, and thus it necessarily follows that plaster of Paris is not a definite hydrate but contains water bound in the state found in zeolites. H. B. Weiser, W. O. Milligan and W. C. Ekholm (*J. Amer. Chem. Soc.*, 58, 1261; 1936) have now published results of X-ray diffraction studies which seem to show that the hemihydrate and dehydrated hemihydrate have not identical structures, as has been asserted. The X-radiograms of the two substances are similar, showing that the structures are similar, but the existence of definite characteristic differences between the two patterns indicates that the water molecules in the hemihydrate occupy fixed positions in the lattice. The results support the view that the hemihydrate is a definite chemical individual, and that the process of dehydration is not zeolitic in character. The isobaric dehydration curves of gypsum also show a very definite break at the composition of the hemihydrate, although both this and anhydrous calcium sulphate adsorb water. The failure of some previous investigators to notice the difference in the X-ray patterns may be due to the use of too small cameras, molybdenum radiation, and failure to use a reference material for standardizing the films. There can be no doubt, the present authors state, that significant differences exist between the X-radiograms of the hemihydrate and its dehydration product when use is made of a relatively large camera, copper radiation, and a standardizing material, and when special care is taken to avoid rehydration of the dehydrated hemihydrate.

# Second International Congress for Microbiology

THE week of July 27–August 1 saw more than a thousand microbiologists from all over the world united in conference at University College under the presidency of Dr. J. C. G. Ledingham, director of the Lister Institute. Six years have elapsed since the first Congress in Paris, the original triennial plan having fallen through for reasons which, in view of the world-wide political and economic unrest, may readily be imagined. Much new and important work was therefore ripe for discussion, and the scientific programme had to be divided into no less than eight sections, devoted each to a special subject.

Section 1, under the presidency of Prof. E. Gotschlich, formerly of Heidelberg and now of Ankara, Turkey, dealt with the general biology of micro-organisms. Selective bacteriostasis (the inhibitory action of such substances as dyestuffs and the products of their own metabolism on the growth of bacteria and fungi) and the preservation of micro-organisms in suspended animation, so to speak, by drying in the frozen state were two of the subjects most actively discussed. Their importance is both theoretical and practical: the latter subject especially, interesting in itself in its implications as regards resting states in more highly organized living creatures, has become practically valuable, since it has been realized how subject to variation the unicellular microbe is during culture in the laboratory, particularly variation by loss of such original properties as virulence.

Section 2, devoted to the viruses and virus diseases in animals and plants, under the presidency of Prof. Doerr, of Basle, had perhaps the greatest body of observations to consider, nearly all new since 1930. The five days of discussion, on the general characteristics of viruses, on the modes of transmission and paths of infection in virus diseases, on the evidence concerning the agency of viruses in the ætiology of new growths and on the mechanism of immunity in virus infection, with its practical applications, might alone have furnished material for a congress. Besides the plant diseases in which 'virus' was first discovered, the common cold and influenza, foot-and-mouth disease of cattle, psittacosis, hydrophobia, yellow fever and malignant tumours were all considered in the light of their experimental production by filtrates from which all but 'ultra-microscopic' life had been removed. Astonishing progress was reported in measuring particles of living matter possessing such pathogenic properties, particles not much greater in size than the molecules of comparatively simple chemical compounds, in purifying them and in studying their behaviour in the body fluids of infected and immune subjects: it is gratifying to note how much of it lies to the credit of British research work.

As Bordet put it, in his address as past president to the general assembly of the Congress, "il n'est point de problème plus passionnant, puisqu'il comporte l'étude de la vie dans ces mystérieuses profondeurs où les dimensions deviennent tellement petites que parfois l'on se demande si l'on est encore en présence d'êtres vivants et si les phénomènes qu'on observe ne sont pas dûs à des principes chimiques doués de propriétés imprévues." Yet these particles have been rendered visible and, as 'elementary bodies', have been collected in suspensions of which a dilution of a millionth or more may still produce disease, and multiply indefinitely. Whether they can so multiply apart from the living tissue is yet unsettled: it seems rather that their reproduction is inseparable from the living cell and may indeed be actually a derangement of the cell's own life process.

Section 3, on bacteria and fungi in relation to disease in man, animals and plants, under the joint presidency of Dr. E. J. Butler of the Agricultural Research Council and Prof. H. Zinsser of Harvard, seemed almost staid and commonplace after such adventures in the unknown. Its subjects of highest interest, perhaps, were (1) the general one, on the significance of serological and cultural types of the pathogenic bacteria and fungi in relation to epidemic, epizootic and epiphytotic outbreaks of disease, and (2) the special discussion on the pathogenic streptococci which appear to cause more varied and widespread human misery and death than any other bacterial species.

Section 4, on economic bacteriology, under the presidency of Prof. R. E. Buchanan of Iowa, U.S.A., had to be divided into three subsections: (a) dairy, (b) water, including sewage and industrial fermentations, and (c) soil microbiology. Each of these had its own specialists conferring on its particular problems, but joining with the other subsections for discussion of a subject of general interest, the metabolism of yeast.

In Section 5, on medical, veterinary and agricultural zoology, with Prof. E. Brumpt of Paris as its president, the most active discussion was that on typhus fever and the rickettsias, with chemotherapy of protozoal infections as a close second. The author of "Rats, Lice and History", Prof. Zinsser, appropriately opened the discussion on the former. The similarities and differences, clinical and serological, in the great 'typhus group' of fevers have all been defined in quite recent years; the biology of the infecting microbes, the rickettsias, is, moreover, of particular interest in relation to life-cycles in bacteria, a fascinating field scarcely yet open to exploration.

Section 6, on serology and immunochemistry, was to have been presided over by the arch-priest of the doctrine of antigenic specificity, Prof. Landsteiner of the Rockefeller Institute. Unfortunately prevented, he was replaced by Dr. P. Hartley of the National Institute at Hampstead, himself a serologist of distinction. The study of antigenic structure—and especially of the structure of the new synthetic antigens, the subject of a joint discussion with Section 7—as the new tool for investigating the architecture of living matter, took almost the whole week of the section's time, though it found a day for the significance of allergy in disease, both as a general hypothesis in pathology and as an explanation of such special cases as the cotton-dust asthma, recently elucidated by Prausnitz in Manchester.

Section 7, on microbiological chemistry, had, naturally, Sir Arthur Harden as its president, and

a particularly long and varied list of contributions, ranging over growth factors in bacterial culture to the influence of substrate on the chemical potentialities of the cell.

Section 8, on specific immunization in the control of human and animal diseases, was presided over by the veteran Prof. W. H. Park of New York. Its programme was the longest of all, since its subject is the immediate practical concern of health officers in every country, all of them anxious to compare notes and to learn new methods in the prophylaxis of disease. Whooping cough, pneumonia, cerebrospinal fever and the streptococcal infections already mentioned were the chief human diseases in which progress was reported in protective and curative immunology, while in veterinary practice the various anærobic infections, especially, had victories to relate since 1930.

So much for the set discussions: perhaps even more valuable, since they dealt with speculations too young and tender for the rough handling of public debate, were the private conversations during the afternoons free from open sessions. How many of these there were, one can judge only from observation of numerous groups of well-known workers with their heads together in eager talk. Such intercourse may well be the most fertile of all the Congress activities.

A full programme of 'scientific visits' had been arranged for the Congress members and most of the well-known institutes for microbiological research in and near London were 'at home' to visitors on at least one day during the week. The Ladies' Committee had, in addition, organized general excursions for sight-seeing round London which proved extremely popular. The Universities of both Oxford and Cambridge invited and entertained with generous hospitality large parties of Congress visitors.

The Congress closed on August 1 with a plenary session at which resolutions for the alteration of the name and statutes of the original International Society for Microbiology were adopted. Future triennial congresses are no longer only one of the activities of a society, in the sense of a body of society members, unlimited in number, but of a new 'Association of Microbiologists', limited in function mainly to congress organization and in number to one delegate from each participating country. Under the new constitution, the United States invited microbiologists to a congress in 1939 to be held in August on the Atlantic seaboard, and this invitation was accepted by the plenary session with acclamation.

# Fruit Supplies in 1935

UNDER the above title, the Imperial Economic Committee has issued a comprehensive supplement to its weekly fruit intelligence notes (London: H.M. Stationery Office, June 1936. 2*s.* 6*d.* net). It will surprise most citizens of the United Kingdom to know that only 79 lb. of fruit per head of the population was eaten in 1935, as against an average of 96 lb. in 1934. Imports of raw fruit, however, exceeded those of any previous year, and made a total of 1,480,000 tons. It is gratifying from an Imperial point of view that 53 per cent of this quantity came from Empire countries overseas, and the amount from this source was greater than the total imports from all sources in the years immediately preceding the Great War.

Home supplies show a rather disturbing variation from year to year, though the acreage under fruit crops does not fluctuate greatly. This is shown in the accompanying table, compiled from information on pages 12 and 14 of the volume, and relating to the orchards and small fruit in England and Wales:

| Year | Acreage | Yield, in cwt. |
|---|---|---|
| 1929 | 313,295 | 11,098,000 |
| 1930 | 318,188 | 10,116,000 |
| 1931 | 306,801 | 5,371,000 |
| 1932 | 306,889 | 5,896,000 |
| 1933 | 309,553 | 9,445,000 |
| 1934 | 315,890 | 16,217,000 |
| 1935 | 321,963 | 4,387,000 |

If the yearly amount of home-produced fruit could be made more or less stable, the consumer would have the benefit of an increased, healthy diet of fruit, whilst the home producer and the importer would find a more uniform and workable market. The reason why the average consumption of fruit was 17 lb. more in 1934 than in 1935 seems to be that there was more than 3½ times the quantity from home sources in the former year than in the latter. Imports could not account for the increased consumption, for 27,069,000 cwt. of fruit came into the country in 1934, and only a slightly larger amount, 29,593,000 cwt., in 1935. Damage by frost may possibly explain the extremely low yield of 1935, though it was not wholly responsible for the small quantities produced in 1931 and 1932. It remains a potent factor, however, as a cause of fluctuating yield, and is beginning to receive the scientific study it deserves.* The so-called "biennial habit" of fruiting, where a year of high yield is followed by a lean season, is not obvious in the returns set forth above. Could not the growers and scientific workers of the country turn their attention to this rather obvious gap in the development of scientific distribution and controlled cropping?

"Fruit Supplies" gives very extensive analyses of the imports of fresh fruit, vegetables, flowers and bulbs into the United Kingdom, and reviews the output of various sources of supply. A useful feature is the statistics of imports into other countries, and the survey should be welcomed by all who are interested in watching the development of Empire resources.

* For example: R. O. Mulligan, "The May Frosts at Wisley", *J. Roy. Hort. Soc.*, 60, 10 (Oct. 1935); A. N. Rawes, "An Orchard-heating Experiment", ibid., 60, 11 (Nov. 1935); J. Grainger and A. L. Allen, "The Internal Temperature of Fruit tree Buds", *Ann. App. Biol.*, 23, 1 (Feb. 1936); T. N. Hoblyn, "Spring Frosts at East Malling 1915–35", Ann. Rep. East Malling Research Station for 1935 (May 1936).

# The Hammond Organ

By Sir James Barrett, K.B.E., C.B., C.M.G.

A GENEROUS but anonymous donor has just presented a Hammond organ to the University of Melbourne; and as I am interested in music, especially orchestral music, I am glad to testify to the excellent results obtained from it. The instrument itself is about the size of a small harmonium; it has two manuals and a pedal register, and a foot lever for producing variation in volume. When used fully, the volume of tone is very great, but the musical beauty of the instrument lies even more in the solo stops or arrangements. The clarionet stop produces something superior to any clarionet I have heard, and the volume of tone can be altered at pleasure. The oboe and violin equivalents are very satisfactory.

By combining the various overtones it is obvious that any instrument can be imitated and even improved. The only adverse criticism I have heard is that when the instrument is used fortissimo it is apt to produce a somewhat raucous tone, but that is a matter for the organist to rectify. As the instrument costs about £800, it seems unlikely that many expensive pipe organs will be built in future; and I have no doubt that the Hammond organ represents the commencement of a new development in music.

The following account of the mechanism was kindly furnished me by the professor of physics in the University of Western Australia, Dr. A. D. Ross:

"A synchronous motor rotates at constant speed a shaft provided with sixty-one iron disks, each fitted with a series of projections like teeth. The speed of rotation and the number of projections is such that for any disk the number of projections passing a given point per second is equal to the frequency of the note represented by the disk. When a key of the keyboard is depressed, a magnet is brought close up to the circumference of the associated disk. The passage of the projections of the iron disk causes periodic fluctuations in the magnetic field of the magnet, and consequent induced current in a coil wound on the pole piece of the magnet. The electromotive force for this current varies harmonically, so that the current when supplied to a loud speaker gives a sine-wave movement to the speaker diaphragm and therefore a pure tone. (Unfortunately the material of the diaphragm has its own natural harmonics which are introduced to a slight extent into the tone, and this is one of the chief practical defects in the instrument.)

"When the key middle C of the keyboard is depressed, not only is a magnet brought up to the disk corresponding to frequency 256, but other magnets to the disks for 512, 768, 1024, etc. (the overtones). Each gives alternating electromotive forces with the above-mentioned periodicities, and resultant currents. These currents all pass through separate variable resistances, controlled by the draw-stops (each of which can be moved in or out in eight stages) and so one can utilize the series of electromotive forces corresponding to frequencies 256, 768, etc., in any desired degree of intensity. When the electromotive forces, so adjusted, are applied to a circuit, a current flows with fluctuations corresponding to all the effects superposed. This is amplified and transmitted to the loud speakers, which must produce a sound which has the same fluctuations and is the combination tone with the several harmonics present in the arranged proportions.

"The sounds given out by orchestral instruments have been investigated by recording the air pressure fluctuations in each wave. These waves are then analysed by Fourier analysis, either mathematically or experimentally, and the harmonics present are found and their relative intensities. (The problem is identical with that of tidal analysis.)

"The Hammond organ can undoubtedly produce a wealth of tone shades different from those of any known instruments. I found it most interesting when experimenting with it to alter a tone in a series of steps (each of which was in itself practically imperceptible) from that of a clarinet to that of the flute or oboe."

# Industrial Use of Electric Batteries

ELECTRICAL engineers have recently been considering the relative merits of vehicles driven by electric batteries and of those driven by petrol. Considerable difference of opinion exists on this point, and so the paper by Dr. Strohe, of Cologne, a translation of which appears in *World Power* of June, is of value as he gives the results of practical tests on the two classes of vehicle.

Dr. Strohe summarizes the relative performances of an electric and a petrol vehicle as follows. Electric vehicles have a life of twenty years and their maintenance costs are five per cent. Petrol vehicles have a life of ten years and their maintenance costs are ten per cent. The 'fuel' costs of the latter are about four times greater than that of the former. The capital cost of the large electric vehicle is now lower than that of a petrol vehicle of similar loading capacity, and in addition the oil required is less and the tires last longer. The economic advantages, therefore, are in favour of the electric vehicle. The results show that the daily performance of an electric commercial vehicle after several years' use lies between 18 and 24 miles, and it can double this distance on one battery charge. Electrical vehicles are now available with speeds up to twenty miles per hour; but the radius can be extended by increasing the size of the battery. Increasing the size of the batteries is only advantageous when the

batteries are in full-time use. Otherwise the heavier batteries mean additional non-paying load.

When the huge alternating current network of the Grid supply was completed, many thought that there would be little further use for storage batteries in connexion with lighting supply. Having practically obtained standardization, it is most unlikely that Great Britain will ever drift back into the large variety of voltages and systems of supply which existed before the advent of the Grid. There have been a few breakdowns and blackouts since the early years of its working, but their number is diminishing. In *Electrical Industries* of May 6, E. C. McKinnon raises the interesting point whether their number is not a secondary consideration to the question of the possibility of their ever occurring at all. The national supply is now so great that to consider emergency duplicates or alternatives for all of it is impracticable, but there are many sections of the community which might be imperilled in the absence of light and power. Statistics show that the list of installations where an alternative supply has been provided so as to be available in the remote possibility of the cutting off of the main supply by storm, riot, enemy's action, etc., is rapidly mounting. Engineers who have been studying the question of emergency plant recognize that there must be no appreciable time lost after a breakdown in putting it into commission.

It has been customary in the past to regard the average working life of a battery of the stationary type to be something over ten years. But this assumes that the battery has been working during this period. A battery that is only used for standby purposes has a much longer life. It is unlikely that any system of telephone supply would be run solely from the public mains. There is always a storage battery in reserve and so continuity of supply is assured. Proprietors of cinemas are compelled by law to instal a lighting supply secondary to the main supply.

The use of the storage battery as the nucleus for the alternative supply is now firmly established. In several hospitals the storage battery is introduced as a means of assuring constant illumination. The chances of interruption of the public supply are very small, but the outlay required to ensure an unfailing brilliant illumination by a storage battery with automatic control is not a serious item and might possibly save the life of a patient. In stores and public buildings the object of installing automatic emergency lighting devices is to prevent panic amongst those present and the prevention of pilfering should there be a breakdown of the main supply.

In central electric stations and electricity works standby batteries are much used to help carry over the peak loads and so delay the inevitable purchase of more generating plant. A large standby battery in a London supply station was kept fully charged by allowing a 'trickle' of current to flow continuously through it. When recently subjected to the annual examination it was found, for all intents and purposes, to be equal to new after nine years' running.

# Turf Nurseries

THE experimental planting work carried out by Sir John Stirling Maxwell at Corrour in Inverness-shire over a long period of years has attained an almost, if not complete, world fame. It was a study of the Belgian system of turf planting which gave Sir John his first successes at Corrour. Since then he has inaugurated what may be considered a sound technique in afforestation work in this type of country.

Sir John has now applied the wide experience gained to the nursery. In the *Scottish Forestry Journal*, 50, Pt. 1 (Edinburgh, March 1936), he describes his method in an article entitled "Turf Nurseries". It is obvious, says the author, that the method has a restricted application; it can only be practised where peat beds are available. The method was suggested by the ease with which it was found possible to move trees planted on upturned turfs for several years after planting. The method is described as follows by the author:

"An area of peat is selected free from roots and boulders. Nothing is more suitable than the *Molinia* flats which are found on nearly all Scots moors. Turfs are lifted and turned over in continuous rows, leaving a space between the trenches from which they are taken just wide enough to carry the line of upturned turfs. These nurseries are best prepared in the autumn and planted in the spring, but this is not essential. The plants are inserted in the centre of each turf, a plug being cut out by a circular spade. A dressing of manure mixed with sand or gravel is applied to the roots of each plant. The plug is broken up and used to fill up the hole. Well-grown 2-year seedlings are the best plants for the purpose. As regards species, we have hitherto only used Sitka and Norway spruce and *Contorta* pine, but Japanese larch, which grows well on certain types of peat, should be equally suitable. As regards the size of nurseries, the ideal arrangement would be to have each nursery just large enough to plant an acre so that no plants would have to be carried more than thirty yards. In practice we have generally found it more convenient to make the nurseries rather larger, since the number of suitable sites is limited. After two years' growth in the nursery the plants are ready to move. They are carried on hand barrows, six or eight turfs to a barrow. Enough plants are left in position to make the nursery part of the wood. For Sitka we leave every fifth plant in every other row. For Norway every fourth plant. The remainder are set out at whatever distance is desired. If the heather is long a space has to be cut or pulled for each turf. Sometimes on very steep slopes it is necessary to make a nick to prevent the turf sliding downhill. The setting out is usually done as soon as the second year's growth is complete. It may be asked why the turfs are not cut where required and placed at once in their permanent positions. The answer is that there is great economy in concentrating all the preparatory work in one spot. Also the turfs are heavy to handle when first cut, whereas after two years' exposure they become much lighter."

Sir John states that the advantage of the system is that the plants receive no check at any stage in their growth; that the method can be used with success on ground where planting in pits or notching would result in prolonged check; and finally, where draining is required, it does not make up for the lack of it. The author discusses the types of countryside on which he thinks the method is applicable. He says that the turf nurseries require little shelter. Nurseries placed on exposed salients at 1,600 ft. in Scotland have produced plants which "would do credit to any lowland nursery". As regards manures, the old Belgian recipe of one part of slag to seven of sand has given the best results.

Sir John is modest, and thinks the scope of the method is limited. This is by no means so certain. There are parts of the Empire, by no means restricted to peat lands, where it is possible that this type of nursery rearing of plants might be applicable both with success and cheapness.

## Educational Topics and Events

Cambridge.—Applications for a John Lucas Walker studentship in pathology are invited and should be sent before September 30 to Prof. H. R. Dean at the Department of Pathology, to whom requests for further information regarding the studentship may be addressed. This studentship will be tenable for such period and will be of such annual value not exceeding £200 as the professor of pathology with the approval of the Managers may determine.

The Board of Management of the Frank Edward Elmore Fund will shortly proceed to the award of not more than three or four studentships for research. The studentships are open to male graduates of any University in any country who were born at any place within the British Empire other than Scotland. The students first appointed will work in the Department of Medicine under the direction of the regius professor of physic. The commencing salary will be £300 a year.

At Clare College, Prof. R. S. Hutton, Goldsmiths' professor of metallurgy, has been elected into a professorial fellowship.

At Emmanuel College, the external studentship offered to graduates of other universities intending to commence residence as research students in October next has been awarded to C. O. Hutton of Otago University, New Zealand, for research in geology.

Scientific research is made self-propagating by the peculiar methods in use by the Wisconsin Alumni Research Foundation. As explained in "A Decade of Service" recording achievements of the first ten years, 1925–35, of the Foundation's existence, this trust started with no invested capital but only a patent application belonging to one of the University professors, Dr. Harry Steenbock. The application, then pending before the United States Patent Office, related to the use of ultra-violet rays to enrich the vitamin D content of foods and medicinal products. A corporation was formed to exploit this patent and any others that might be similarly acquired from members of the University. In ten years the earnings of the Steenbock patent alone have enriched the University by nearly 700,000 dollars and provided an endowment worth more than 125,000 dollars a year for the future needs of research.

## Science News a Century Ago

### Use of Coal in American Steam-boats

According to Admiral Preble, up to the year 1834, steam-boats in the United States burnt wood only. On August 18, 1836, *The Times* published a note from the *New York Evening Star* about the steam-boat *Novelty*, which said that "recent successful experiments of driving this boat, of the largest class, with anthracite coal, against the tide and a strong current at 16 miles an hour has caused much remark in the city, as an astonishing fact of great importance on the subject of fuel which may lead to revolutions in steam navigation. Dr. Knott, the distinguished president of Union College, is the proprietor of the *Novelty*, which he constructed, we believe, with machinery after his own ingenious invention. The fact of the practicability of using anthracite being now ascertained so as to produce as great a degree of heat as pine-wood, will no longer compel steam-boat proprietors to import their wood at exorbitant prices from the remote forests of Maine and the shores of the Chesapeake. Nearby, and almost at our doors, we have the anthracite coal mines of Pennsylvania, of every possible variety, in exhaustless quantities. The successful navigation of the Atlantic from America to Europe is made certain. Wood is now selling at the Hudson, at five or six dollars a cord. The cost, in fact, of pine-wood is about double that of anthracite."

### Progress of Ballooning

In 1836, balloon ascents were very frequent, and considerable sums were paid by passengers desiring to make an aerial voyage. The subject was one of great public interest, and on August 18, 1836, *The Times* in an article on "Aerostation" gave a chronological account of some of the landmarks in ballooning. In this article it said on September 19, 1736, J. Montgolfier sent up a balloon in Paris, filled in eleven minutes with the smoke of burnt straw and wool. Montgolfier then made a balloon of spherical form 45 feet in diameter and 75 feet high in which Pilatre de Rozier ascended, he having the honour of being the first aeronaut. On December 1, 1783, a balloon filled with hydrogen gas took up aeronauts in the persons of MM. Charles and Robert. In 1784 Madame Thible ascended at Lyons before the King of Sweden. She was the first aeronaute. On June 18, 1786, Mr. Festin ascended from Paris, and remained a whole night in the sky. On November 25, 1783, the first ascent in England was made by Count Zambecarri, from the Woolwich Artillery ground. He descended at Petworth. On September 21, 1784, the Chevalier Lunardi made the first ascent from London. On January 7, 1785, Mr. Blanchard and Dr. Jeffries, an American physician, ascended at Dover and descended near Calais. After referring to the use of balloons in military operations, the article concluded with the observation that balloons have not justified the expectations they raised.

### Death of Edward Turner Bennett

On August 21, 1836, Edward Turner Bennett, secretary of the Zoological Society, died at the early age of thirty-nine years. Born at Hackney on January 6, 1797, he was trained as a surgeon, and practised for several years near Portman Square. He devoted himself with the greatest ardour to the

study of zoology. He took an active part in forming an entomological society and the Zoological Society. Of the latter he was at first vice-secretary, and from 1831 until his death the secretary. He contributed many papers to the *Transactions of the Zoological Society* and published "The Tower Menagerie" (1829) and the "Gardens and Menagerie of the Zoological Society" (1831). He also prepared an edition of White's "Natural History of Selborne", with numerous notes, which was published after his death. "From the affability of his manners and general scientific and literary attainments," said one writer, "he was highly respected by a numerous circle of friends."

#### The British Association at Bristol

THE sixth meeting of the British Association took place at Bristol during the week August 22–27, 1836. The proceedings were fully dealt with in the *Athenæum*, which published several double numbers. On Thursday, August 18, the correspondent of the journal wrote: "There is every fair prospect that the meeting will rival that in Dublin, both in the number and the high scientific character of its members. . . . Upwards of 600 new members were enrolled up to Wednesday evening. . . . As far as can be at present foreseen, Geology and Mechanical Science are likely to be the most important Sections. Reports are current that the Rev. Mr. M'Gawley's discovery of the possibility of deriving a motive power from electromagnetism . . . has received a new and important extension which may make sad havoc with steam and railway speculation—but on this subject your readers will soon be able to judge for themselves". Writing again on August 20, the correspondent said that the General Committee had received a letter from the Marquis of Landsdowne expressing his regret that he would not be able to take the chair owing to the illness of his son, and the committee had therefore elected the Marquis of Northampton as vice-president. "It was gratifying," he added, "to observe that all traces of the temporary estrangement of Sir David Brewster from his colleagues on the Council had disappeared".

## Societies and Academies

### Dublin

Royal Irish Academy, June 22.

C. F. HUMPHRIES and W. E. FROST: The Chironomid fauna of the mosses of the River Liffey. Quantitative samples of mosses were taken from the River Liffey (Ireland) from two contrasting stations; one where the water was acid and one where it was alkaline. The species of Chironomid larvæ found in the mosses were identified; the Orthocladiariæ constitute more than ninety per cent of the fauna at both places. The larval Chironomidæ are equally abundant in the acid and alkaline waters, and show only minor qualitative differences. Some notes on the seasonal distribution are given. Four new types are described and figured.

ARTHUR HOLMES: New analyses of Tertiary igneous rocks (Antrim and Staffa). Pending the publication of certain investigations by Dr. F. Allison and the author, it was thought desirable to make available four new analyses of rocks, made in the course of that work. Three of these are from Co. Antrim, namely, rhyolite, Tardree Mountain; olivine-dolerite, Portrush Sill; and basalt, Giant's Causeway. The fourth is the olivine-basalt of Fingal's Cave, Staffa.

JOSEPH ALGAR: The synthesis of diflavonols. Diflavonols may be synthesized by treating dihydroxy-dichalkones, such as dibenzylidene-diacetoresorcinol, with aqueous alcoholic sodium hydroxide and hydrogen peroxide. In this manner the following have been prepared, with satisfactory yields:— diflavonol; 4′.4″-dimethoxy-diflavonol; 3′.4′-3″.4″-tetramethoxy-diflavonol; 3′.4′-3″.4″-dimethylene-dioxy-diflavonol. Since dihydroxy-dichalkones are readily obtained from diacetoresorcinol and the suitable aldehyde, the reaction affords a convenient general method for the synthesis of diflavonols.

### Brussels

Royal Academy (*Bull. Classe Sci.*, No. 4, 1936).

G. CESÀRO and J. MÉLON: On cryolite. Refractive index, birefringence perpendicular to various faces and crystalline forms.

J. E. VERSCHAFFELT: The thermo-mechanics of the surface layer. (1) Generalities. (2) The adsorption formula. (3) Mixed phases.

E. DE WILDEMAN and E. VERLEYEN: The budding of the epiphylous tissues in some monocotyledons.

M. DEHALU: Bernstein's theory relating to the hereditary probabilities of blood groups.

L. GODEAUX: Some involutions belonging to the generalized Humbert surface.

P. GÉRARD: The homology between the sense organs of the lateral system and those of the vestibular system in the teleosteans.

P. L. CATTALA: Photo-electric recording of the time of passage of stars. Preliminary theoretical study: variation of the luminous flux through a reticule at the passage of a stellar image.

R. CORDIER: The cutaneous sense organs of *Protopterus*.

G. VAN LERBERGHE and P. GLANSDORFF: Contribution to the thermodynamics of open systems.

E. ANGLADE: Flecnodal surfaces of a ruled surface.

L. DERWIDUÉ: Linear congruence of conics.

B. GAMBIER: Study of the cubic surfaces which can possess Eckardt points.

J. L. DESTOUCHES: Role of the notion of stability in physics.

L. MARTIN: Problems of the limits relative to certain systems of partial differential equations.

G. SOKOLOFF: Singular trajectories in the problem of three bodies which attract each other proportionally to their masses and to a function of the distance (2).

M. LECAT: Remark on the note entitled: "The logical foundations of the theory of probabilities", by S. Avsitidysky.

JEANNE HENRY-CORNET: Study of the absorption spectrum of bilirubin.

### Cracow

Polish Academy of Science and Letters, May 4.

G. GIRAUD: A property of certain generalized logarithmic potentials.

J. WEYSSENHOFF and A. BIELECKI: Quaternions, rotations in space of four dimensions, and the formula of Cayley.

M. MIESOWICZ: The influence of the magnetic field on the viscosity of liquids in the nematic phase. A magnetic field produces a marked increase in the viscosity of *p*-azoxyanisol and *p*-azoxyphenetol in the nematic phase.

B. KAMIENSKI and J. INGLOT : (1) The dielectric potential and surface tension of cholic acid solutions with different concentrations of hydrogen ions. (2) The influence of the hydrogen ion concentration on the dielectric potential of a solution of potassium chloride.

K. SMOLENSKI and W. KOZLOWSKI : The rotatory power of alkaline solutions of saccharose.

MLLE. R. LUDWICZAK and J. SUSZKO : Alloquinidine, a carbinol base derived from quinidine.

J. SUSZKO and M. WDOWICKI : Naphthalylmalonic ether and peri-naphthindandiono-carboxylic acid.

K. KONIOR : The profile of the Dziedzice Pleistocene.

M. KSIAZKIEWICZ : The structure of the Lanckorona zone.

M. MEREMINSKI : The development of the embryo-sac in *Begonia incana*. Contribution to the embryology of the genus *Begonia*.

S. MIKULSKI : The influence of alternating temperatures on the development of the eggs of batrachians : *Bufo americanus* and *Ambystoma tigrinum*.

J. ZACWILICHOWSKI : Researches on the innervation and the sensorial organs of the wings of *Isopteryx tripunctata*.

T. GARBOWSKI : The repetition of instinctive acts generally done once only. Remarks on some experiments on Dicranura and Cerura approaching the chrysalis stage.

June 8.

G. GIRAUD : A generalization of logarithmic potentials of a double layer.

A. JAGIELSKI : The dielectric polarization of the liquid chloronitrobenzenes.

S. DOBINSKI and J. WESOLOWSKI : The density of liquid selenium. The density of selenium between 228° C. and 345° C. is a linear function of the temperature, and shows no sudden variations corresponding to those found by Pélabon in the electrical conductivity of this substance.

A. ZIEMECKI and K. NARKIEWICZ-JODKO : The continuity of the variation of the cosmic radiation in the upper layers of the troposphere. The results of G. A. Suchstorff were not confirmed, and the authors regard it as unlikely that radioactive bodies are present in the higher regions of the atmosphere.

M. KAMIENSKI : Study of the motion of the Wolf I comet.

F. KEPINSKI : The movement of the periodic comet Kopff (1906 *e*).

K. SMOLENSKI and S. POREJKO : The *p*H of solutions of lime in water and in solutions of saccharose.

L. MARCHLEWSKI and MLLE. R. GRÜNBAUM : Absorption of ultra-violet radiation by gossypol.

W. GOSLAWSKI : The influence of the hydrogen ion concentration on the dielectric potential and surface tension of solutions of cinchonine and cinchonidine.

J. SZAFLARSKI : Remarks on the thermal properties, transparency and colour of the lakes of the south-west part of the High-Tatra massif.

MLLE. J. DYAKOWSKA : The interglacial period at Poniemunie near Grodno.

T. LITYNSKI : The estimation of nucleic phosphorus in the seeds of the bean, *Vicia Faba minor*.

MME. W. ZABLOCKA : The mycorrhiza in the genus *Viola*.

K. ROUPPERT : The leaf of *Philodendron squamiferum*.

J. MAROLSKI and ST. SMRECZYNSKI : The Coleoptera of the Pleistocene of Leki Dolne, near Pilzno.

F. ROGOZINSKI and ZB. GLOWCZYNSKI : The behaviour of some liposoluble colouring matters in the animal organism.

## Moscow

Academy of Sciences (*C.R.*, 1, No. 8, 1936.)

A. MARKOV : Some theorems on the Abelian entities.

A. DANILEVSKI and M. KREIN : The bilinear developments of symmetrical nuclei, positive in Mercer's sense.

D. MORDUCHAJ-BOLTOVSKOJ : The impossibility of expressing modular functions in a finite form by elementary ones.

I. BESSONOV : The Brownian movement of a linear grid.

I. N. NAZAROV : Splitting and isomerization of olefines indicating a tertiary radical.

M. P. VOLAROVICH, D. M. TOLSTOJ and L. I. KORCHEMKIN : A study of the viscosity of molten lavas from Mount Alaghez.

M. NEUHAUS : Frequency of occurrence of spontaneous lethals in mature and immature germ cells of *Drosophila melanogaster*.

## Tokyo

Imperial Academy, May 12 (*Proc.*, 5, 109–146).

H. HOMBU : Theory of affinor transformations.

T. TANNAKA : Existence of a Galois field with a given *p* group.

T. NAKAYAMA : The algebras over a field with a prime number characteristic (2).

H. KIMURA : (1) Provisional result of the work of the International Latitude Service in the North Parallel + 39° 8′ during the year 1935. (2) Preliminary result of the observations made at Adelaide International Latitude Station during the year 1935. (3) Preliminary result of the observations made at La Plata International Latitude Station during the period 1934.64–1935.97.

Y. HAGIHARA : The speed of corpuscles ejected from stellar atmospheres. The speed of ejection of an atom from a star is calculated by a quantum theoretical method which gives Milne's result as a particular case.

T. ARAKI and M. KURIHARA : The relation between the intensity of the emission lines and the displacement towards the violet of the absorption lines in the spectrum of *P* Cygni. An empirical formula is derived from published results.

S. NISHIKAWA, S. NAKAGAWA and I. SUMOTO : Slowing down of neutrons by thin layers of paraffin.

S. AKABORI and T. KANEKO : A perfume containing sulphur derived from soya.

F. HOMMA : A method of delineating a curve representing the variation of chemical composition in a zoned plagioclase.

K. TANAKA : Remarkable glaciated rocks found in the high mountains of the central upland of Japan.

S. ENDÔ and H. OKUTSU : *Glyptostrobus* cone from the *Liriodendron* bed near Sendai.

H. YABE and M. EGUCHI : *Eohydnophora*, a new genus of Cretaceous corals.

T. SUGIURA : A list of chromosome numbers in angiosperms (2).

# Official Publications Received

## Great Britain and Ireland

Forestry Commission. Sixteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1935. Pp. 45. (London: H.M. Stationery Office.) 1s. net. [167

The National Physical Laboratory. Physical Constants of Pure Metals. Pp. 27. (London: H.M. Stationery Office.) 6d. net. [187

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1935. Pp. 250. (Bristol: The University.) [187

The Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1936. Pp. 20. (Ayr: Hannah Dairy Research Institute.) [207

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# Research and Teaching in Universities

ONE of the most impressive passages in the recent report of the University Grants Committee is that in which attention is directed to the opportunity of service before the universities to-day in training the right type of leader, competent to think strenuously about great issues of right and wrong, liberty and government, and to bring to the grave problems of to-day minds richly informed and unsleeping in the exercise of critical intelligence, and imaginatively alive to the human issues underlying the decisions they are called upon to make. In an age when appeals to mass hysteria often appear to be more successful than appeals to reason, it is of the utmost importance that a university training should enhance a man's equipment not only as a skilled worker but also as a member of society and a human being.

The desirability of closer contact between the universities and the life of the community was also emphasized in speeches at the banquet on June 29 in connexion with the centenary celebrations of the University of London. Prof. L. Cazamian, of the University of Paris, referred to the function of the university in developing the unselfish love of peace, and a creative instinct of fair play to all the nations. The slow victory of a ripe spirit of justice over the promptings of blood, life and force is a subject for noble pride that something of the will to power of past ages might be sacrificed to a new hope and a new faith.

In a speech on the same occasion, Sir James Barrett directed attention to the value of a university as a place where a problem could be discussed without being overlaid by political and financial considerations. A university, however, cannot speak in the collective sense, and if a professor speaks individually he is apt to be criticized if his notions do not agree with those of some of his hearers. Sir James Barrett suggested that the function of universities as a whole to meet the crying need of a world in constant travail is the production of men with balanced minds, organized intelligence and common sense.

This plea that the universities should no longer be regarded as unco-ordinated centres of specialized knowledge, but should come into closer contact with social problems and give an enlightened lead to the community independently of political parties, has frequently been advocated in different ways during recent years. Essentially it involves two separate questions. The first is the impartial study of social and economic questions, as has been carried out in recent years by the Research Section of the Department of Economics and Commerce at the University of Manchester under the leadership of Mr. John Jewkes. The second is the training of leaders for the community who possess the vision and personality to compel action along the lines indicated as a result of such investigations.

In regard to the first, Sir James Barrett suggested that some system of interlinked university research throughout the world, on the lines of that developed internally in the Commonwealth of Australia under the Council of Scientific and Industrial Research, is required. Without an educated public, however, it is almost impossible to ensure that the results of such investigations are fully utilized for the advantage of the community.

The problem is thus one of education and teaching as well as research or investigation, and the question of the right relation between teaching and research in the universities is one of the most important of those raised by the recent report of

the University Grants Committee. It has since been discussed in a valuable article by Dr. R. Coulborn in the *Nineteenth Century*, and reference was made to the same problem by the Prime Minister in opening the fifth Congress of Universities of the British Empire at Cambridge on July 14.

Unquestionably one of our first needs is the re-orientation of research at the universities, and the institution of research in the biological sciences and the humanities, so that we may be in a better position to deal with the many social problems with which the unparalleled and disproportioned development of the physical sciences has confronted us. In such work the prime need is for creative research, and Dr. Coulborn does well to remind us that much research work can be, and is, undertaken without any preceding act of creation. In fact, the patience, dexterity and precision demanded in so much research to-day tend to blunt the enthusiasm, imagination or vision of the investigator. He tends to become a machine, and cannot easily escape some warping of his mind or loss of humanity.

These effects of specialization cause the research worker to lose interest in teaching, and it is for this reason rather than to free the investigator from other distractions, as Mr. Baldwin suggests, that some reconsideration of the close connexion between research and teaching which at present exists in the universities is desirable. Undoubtedly it is true that the investigator of genius, the man with really creative ability, should be free from other claims on his time so far as possible. It is equally true that he is likely to be lacking in the patience which research demands, and will require a number of other workers to carry out the detailed work along the lines his genius suggests. It may also be true that his creative ability will be combined with a capacity for inspiring enthusiasm in others and thus for some measure of teaching, which is the fundamental reason for believing that the university teacher should himself be engaged in original work in his subject.

Such men, however, will always be the exceptions, and Dr. Coulborn's warning as to the damaging effects of research in university education cannot be lightly disregarded. He considers that the numbing influence of research on character destroys the teacher's ability to interest and inspire, while undergraduate studies are also usually planned on a basis of progressive narrowing down towards research minutiæ instead of being such as to offer the student the deepest understanding of his subject. If we accept the view urged by Mr. C. H. A. Wilson, vice-chancellor of the University of Cambridge at the recent Universities Congress, that the universities are national and imperial institutions, and that it is their duty to train against a background of pure scholarship men and women who are fitted to take a lead, or at any rate a creditable part, in the conduct of social, commercial and political administration, the question of the quality of the teaching given acquires primary importance.

The evidence cited by Dr. Coulborn suggests that our present practice of linking teaching and research is inefficient even from the point of view of research, and that much superior results would be obtained if the functions of research and teaching were entirely separated and made full-time occupations. Not only is it probable that teaching would be more effective and inspiring and more adapted to the social needs of the student if such a division were effected, but also it would be easier in the transition to secure a re-orientation and direction of academic research in the fields in which it is most demanded by the needs of the community. Moreover, a check would be given to that untoward tendency for undergraduate training to approximate to a soul-destroying professional training instead of the training in scholarship, in strength of character, and in potentialities of good citizenship, which it should be the glory of a university to give as a preliminary foundation of professional training.

There need be no fear that such a separation of functions would lead to any debasement of research. On the contrary, it is more likely to enhance its repute if the conduct of research is a full-time activity of investigators appointed for the purpose rather than the part-time activity of a lecturer or an aspirant for a higher degree. The prestige of research could only be enhanced by being placed on a footing which would enable its real leaders and men of genius to direct and inspire the large army of patient investigators whose co-operation is so essential in any advance to-day.

One of the most important consequences of such a separation of functions would equally be the encouragement which could be given to the really great teacher with a genuine talent for exposition and inspiring others. Such teachers, though teaching may be their whole occupation, will never fail of that constant refreshment at the fountain heads of knowledge which is essential if their

teaching is to retain its freshness and vitality. The present interrelation of research and teaching, in fact, has few more untoward consequences than the way in which it tends to diminish the prestige or status of such expositors who, whether within the walls of a university or in the nation at large, are one of the greatest needs to-day. Only through the work of sincere, able and fearless expositors can we hope that either the alumni of our universities will awake to the vastness of their opportunities of leadership and constructive service in the world to-day, or humanity at large realize how great are the benefits which the acceptance of such leadership could confer upon them. The separation of teaching from research in such ways as these may well advance the dignity of both, and enable the universities to make an ever-growing contribution to our national and imperial well-being. This service will be rendered alike through the provision of exact and impartial knowledge and analysis of the factors concerned in many of our grave social or economic problems to-day, and in the training and inspiring of those who can bring to bear upon them constructive criticism, moral courage, a wide vision and a keen sense of human values.

# Native Agriculture in Africa and its Relationship to Population

**The Improvement of Native Agriculture in relation to Population and Public Health**
By Sir A. Daniel Hall. (University of London: Heath Clark Lectures, 1935, delivered at the London School of Hygiene and Tropical Medicine.) Pp. vii+104. (London: Oxford University Press, 1936.) 10*s*. 6*d*. net.

IN this book, Sir Daniel Hall deals with some of the many problems which have arisen from the impact of modern civilization on the native tribes of Africa. The increase in the human population and in the number of cattle which followed the stoppage of war and the reduction in epidemic disease has led to a dangerous condition—"The eminent consequences are disease due to inadequate diet, tribal unrest and the spread of the desert".

Primitive native agriculture is carried on by the method of 'shifting cultivation'. A piece of bush or forest is burned, and the ashes scattered. On this virgin soil crops are grown for one or two years, by which time the land is overrun by weeds. It is easier to burn another area than clear the weeds and fertilize the soil, so a further area of primitive jungle or forest is burned. So long as the population was small, Nature could repair the damage at leisure. But the population has increased to such an extent that regeneration no longer keeps pace with destruction. Apart from the increase in the population, the process of destruction is increasing owing to the growing of cotton and other products by the native for sale.

To the destruction of the land by the natives there is added the destruction by domestic animals. The increase in the number of cattle, sheep and goats has upset the balance between the grazing animal and the pasture. The pasture gets eaten down to the very roots, and even the roots are destroyed by the goats. On the slopes, the tropical rain washes away the top fertile soil, no longer bound by the mat of vegetation. There results an area completely denuded of vegetation. In this way the desert is steadily spreading. This is a problem which is not confined to East Africa. Soil erosion due to over-stocking has become a most serious problem in various parts of the world.

Unfortunately, the native will not sell his cattle. The wealth and prestige of the family and the tribe depend upon the number of cattle, and the possession of cattle is interwoven with the social and religious structure of native life. Cattle, sheep and goats are, to the African native, even more important than money is to the modern European. Immense numbers are kept quite independently of their value for food or any useful purpose, except the maintenance of wealth and prestige. It will be exceedingly difficult to demonetize cattle in East Africa.

Associated with the problem of the growing population with decreased fertility of soil, is the widespread occurrence of malnutrition. Inadequate diet is one "if not the chief source of disease among African natives". If the health of the native is to be improved, the improvement must begin with better food.

After reviewing the present conditions and showing how they have arisen, the author in the final chapter suggests what should be done to prevent "famine and the spread of desert" replacing war and pestilence, as a means of reducing the

population. The essentials of a new system are: "(1) the replacement of shifting cultivation by a fixed agriculture which will maintain continuous production from a smaller area, leading to a more balanced dietary; (2) the elimination of excessive live stock and the utilization of the remainder to provide food; (3) the prevention of soil erosion and the reconditioning of the devastated areas".

Sir Daniel Hall has brought to bear on this problem of East Africa his great fund of biological scientific knowledge, and his long administrative experience. The results of his study given in this book are an interesting illustration of the value of approaching political and economic problems from the point of view of the man of science, who is accustomed to dealing with ascertained facts rather than preconceived political ideas.

This book should be read not only by those who are interested in the great problem of the native races of Africa, but also by those interested in the application of science to present-day world-wide problems of economics. J. B. ORR.

# Concentrated Solutions

**Les solutions concentrées:** théorie et applications aux mélanges binaires de composés organiques. Par Prof. Jean Timmermann. Pp. vi + 646. (Paris: Masson et Cie, 1936.) n.p.

FIFTY years ago, important advances were made when Arrhenius and van't Hoff made their classical studies on the conductivity and osmotic pressure of aqueous solutions; but the rules which they established were valid only for dilute solutions, and in most cases were rigidly true only at dilutions at the extreme end of the range, where the percentage of the solute is only a very minute fraction of the whole. Prof. Timmermann's book, on the other hand, is concerned with those solutions in which the two components are present in comparable quantities. Its scope is indicated by the exclusion of all systems for which there are no data between 10 and 90 gm. per cent, or only one datum between 10–20 per cent or 80–90 per cent. A sub-title also restricts the book to "theory, and applications to *binary* mixtures of *organic* compounds".

Even with this limitation, the data occupy a volume of 600 pages, which is illustrated by a series of 540 figures, many of which include more than one property in the same figure. The book is, however, by no means a mere dictionary, since it begins very happily with a fascinating account of the admixture of compounds the molecules of which are mirror images of one another. Seven diagrams show the freezing points of mixtures of *d*- and *l*-forms of various optically active compounds, some of which (for example, methyl tartrate and butyl phthalate) form a crystalline racemate with a higher melting point than either of the active components, whilst others (for example, phenylglycollic acid) form a less stable racemate of lower melting point. In other cases again, the *d*- and *l*-forms are isomorphous, and yield 'solid solutions' in all proportions, as in the remarkable case of *d*- and *l*-camphoroxime, or within narrower limits of miscibility. The difficult question of the existence or persistence of racemic compounds in the liquid state is answered in the affirmative in certain instances by a study of the experimental data now cited.

The second chapter of the book extends this study to mixtures of *isomers* which are not mirror images of one another, but differ either in configuration (stereoisomers) or in constitution, and of *polymers* which differ also in molecular weight. In this series of mixtures a clear distinction is drawn between (*a*) *static isomers* (or polymers) where, in spite of their identity of composition, each component is a stable well-defined compound, yielding true solutions when mixed, such as propionaldehyde and acetone, or acetylene and benzene; (*b*) *dynamic isomers* (or polymers) which behave as static isomers in the absence of a catalyst, or in presence of a negative catalyst, but undergo reversible change in presence of a positive catalyst, such as acetaldehyde and paraldehyde in presence of sulphuric acid; (*c*) *tautomers*, to which more than one molecular structure can be assigned, but which are too mobile to be separated into two constituents, such as (i) 1:2 and 1:6 dichlorobenzene, or (ii) stereoisomers which are interconvertible by free rotation about a single bond. Examples which are cited of the group of interconvertible isomers include (i) the dichloroacetylenes studied by Chavanne (and seven other pairs of olefines) which are interconvertible when pure, but can be stabilized by the addition of alcohol, (ii) ten pairs of interconvertible stereoisomers, including two pairs of oximes and the classical examples of fumaric and maleic acids, (iii) acetaldehyde and paraldehyde, (iv) ammonium sulphocyanide and thiourea, studied in very full detail by Werner in Dublin.

In the third chapter of the book, the compounds which are mixed need not be identical in composition, provided that they are sufficiently similar to form isomorphous mixtures. In this field the author (following Bruni) has himself done important work. Thus, in spite of free rotation in the liquid state, ethylene dichloride (I) evidently takes up preferentially a *trans*-configuration, since it forms mixed crystals with the *trans*-form II of dichloroethylene, but a eutectic with the *cis*-form III of this compound, the configurations of which are fixed by the presence of a double bond.

| I. | II. | III. | IV. |
|---|---|---|---|
| $CH_2Cl$ | $Cl{\cdot}C{\cdot}H$ | $Cl{\cdot}C{\cdot}H$ | $CHCl_2$ |
| $\vert$ | $\Vert$ | $\Vert$ | $\vert$ |
| $CH_2Cl$ | $H{\cdot}C{\cdot}Cl$ | $Cl{\cdot}C{\cdot}H$ | $CHCl_2$ |

On the other hand, he has discovered, *inter alia*, that ethylene dichloride (I) forms an equimolecular compound with the symmetrical form of the tetrachloro-compound, IV. The formation of equimolecular aggregates of this type is attributed to the preferential packing of complementary molecules of I and IV, in just the same way that an equimolecular mixture of *d*- and *l*-tartaric acids forms a more stable aggregate than either type of molecule separately. In order to recall this analogy, the equimolecular mixtures are described as "racemoïds".

The fourth chapter of the book deals with mixtures of substances of similar type, for example, homologous hydrocarbons, alcohols, esters and amines, substitution products such as $C_2H_4Cl_2$ and $C_2H_2Cl_4$ or *di*- and *tri*-nitrotoluene, and mixtures of compounds with unequal numbers of aromatic rings, such as the binary mixtures formed by benzene, naphthalene and anthracene.

In the preceding systems, which form Part 1 of the book, analogy of structure between the components often produces simple relations in the physical properties of the mixtures, although this is very far from being universally true. Part 2, on the other hand, deals with components of different chemical types, and Part 3 with systems in which one of the components includes a hydroxyl group. The relationships are now more complicated, and long tables are given of mixtures which are 'azeotropic', because they form mixtures of minimum (or more rarely, maximum) boiling point. (The introduction of the term by Wade and Merrimann in 1911 is cited on p. 159.) Shorter lists are also given of pairs of substances which yield two liquid layers at temperatures below the 'critical solution temperature'. Even in these more complicated sections, however, the book never reverts to the status of a mere catalogue, since the reader will find various special subjects, such as the influence of solvents on optical rotatory power, or the behaviour of systems containing anisotropic liquids, adequately discussed, with diagrams and references to the original literature.

The bibliography at the end of the book covers 26 pages, papers published in the same year being given a serial letter, for example, 1914 *b*, which (with the date) suffices to define the reference. The mixtures are indexed in the sequence of formulæ used in Richter's "Lexicon", beginning with methane, $CH_4$, and ending with tristearine, $C_{57}H_{110}O_6$, the component with the simpler formula in Richter's sequence being chosen for the primary entry in the index. The second component of the mixture is then indexed in the same sequence under the first component. Since the formula of each component is accompanied by the name of the compound in question, isomers are always grouped together but are clearly distinguished from one another.

The book as a whole is a monument to the patience and skill of the author, who has rendered a real service to his colleagues by undertaking so formidable a task for their benefit. T. M. L.

# A New 'Oxford Atlas'

**The Oxford Advanced Atlas**
By John Bartholomew. Fifth edition. Pp. iv+96+32. (London: Oxford University Press, 1936.) 10*s*. 6*d*. net.

THE outstanding feature of the new "Oxford Advanced Atlas" is a larger page with larger maps. This has allowed of the introduction of double-page maps of the Iberian Peninsula and the Balkan States. With their inclusion, the atlas now shows the whole of Western, Central, and Mediterranean Europe on the 1 : 3,000,000 scale. There are also new double-page maps of the U.S.S.R., South-West Asia, the Malay Archipelago, the Laurentic Basin, Central and East Africa, and South Africa.

The atlas is thoroughly up-to-date. The "Sarre" of previous editions has become the "Saar", with the former northern and eastern frontier lines deleted. The new and highly significant railway links between Polish Silesia and Gdynia are shown, and British coal exporters as well as Danzig shippers are likely to be affected by them. The map of the Soviet Union is especially useful, since

it emphasizes the essential unity of the European and Asiatic territories of Russia, and their relationship to the marginal lands of Mongolia and Manchukuo. Moreover, it is now possible to locate much-advertised names like Gorki, Dnieprostroy, and Magnitogorsk.

Mercator's projection has been banished from the atlas, except in an illustration on the pages devoted to map projections in general, and the atlas now lacks a serviceable map of world shipping routes. The world political and population maps are drawn on a new equal-area projection termed the Re-Centred Sinusoidal. This shows the land areas true to scale with a minimum of distortion. There is also a valuable map on the morphology of Europe, embodying a more precise classification of the relief features (on the basis of structure) than has hitherto obtained.

In the case of the British Isles, what are described as "the rather elementary county-coloured maps of the earlier editions" have been omitted. One result is that the atlas lacks a satisfactory map of the counties of the British Isles, which seems a pity in view of our strongly developed territorial sense. Another result is that many places found in previous editions do not occur in the present one. To give a test case—the fourth edition marks nineteen places in Hampshire and the Isle of Wight which do not occur in the present edition. It would be ungracious, however, to labour this deficiency in view of the full measure provided elsewhere in this beautifully produced atlas. The claim of the publishers that it should prove "well-nigh indispensable to all who wish to take an intelligent interest in the world they live in" is justified. It definitely supersedes previous editions.

# Fish and Fishing

(1) Letters to a Salmon Fisher's Sons
By A. H. Chaytor. Fourth edition. Pp. xxviii + 316 + 8 plates. (London: John Murray, 1936.) 9*s*. net.

(2) Sea Trout and Trout
By W. J. M. Menzies. Pp. 230 + 16 plates. (London: Edward Arnold and Co., 1936.) 10*s*. 6*d*. net.

(3) Trout Heresy
By P. B. M. Allan. Pp. 206. (London: Philip Allan and Co., Ltd., 1936.) 8*s*. 6*d*. net.

(1) SINCE the publication of the third edition of this well-known book, the author has died. It is, as its title suggests, in the form of a series of letters from an ardent salmon fisher to his sons. Presented in this way the information is simply, although adequately, set forth, and it is possible that the author's legal training has a great deal to do with the clarity with which he makes his points. It is evidently the result of long experience, and written in a manner that can be read by the beginner and more experienced angler with equal profit and enjoyment. The present edition is prefaced with a short sketch of the author by Mr. A. Drewett Chaytor, one of the sons for whom the letters were originally written.

(2) Mr. Menzies, the author of "Sea Trout and Trout" is particularly well qualified for his task. As inspector of salmon (including trout) fisheries for Scotland, he has access to the literature of the many researches that have been conducted in this field. During the past fifteen years a great deal has been done in various countries, but particularly in Scotland, to extend our knowledge of the life-history and habits of the trout, and in this work the author has taken a prominent part. In addition, he is an enthusiastic fisherman with an exceptionally wide knowledge of all the Scottish waters. Thus in telling his story he is able to utilize the most recent information to illustrate those points in which the ordinary naturalist and the angler are interested, and he has achieved considerable success.

The modern view is that sea-trout and trout are simply the migratory and non-migratory races of the same species. After some general chapters the book passes on to the life-history of the two races, from the spawning in the redd, through the smolt, whitling and kelt to the old fish again, and the various problems connected with each of them are succinctly dealt with. Such problems include the determination of age from the scales, the food, the results of marking experiments and the seasonal movements. The concluding chapters treat of diseases, abnormalities, parasites, homing instinct and the making and preserving of a sea-trout fishery.

The book is furnished with an index and a short but useful bibliography; it is well illustrated and printed. The straightforward manner in which it is written should give it a wide appeal.

(3) This volume approaches the problem of fishing from yet another point of view, for the first treats of the art of catching fish, the second of the science of their lives and the third of the psychology of the fish and, by inference, that of the fisherman. The author examines the physical

and more particularly the mental equipment of the trout, its senses and their modes of action. This is done in the light of comparative psychology to a considerable extent, but also in the light of a great deal of actual observation by the author and other experienced anglers.

Certain writers tend to endow the trout with almost superhuman attributes, an attitude explained thus: "The rest of the truth is that be we never so skilful, boast we half a century of experience, we can catch trout but little more easily —if at all—than when we were striplings. There *must* be something in it—quite obviously trout are extremely cunning fish." A quotation from such a eulogy serves as an excellent Aunt Sally to be knocked down by the author with considerable gusto. What are the parts played by instinct and intelligence in this cunning? Can the fish profit by experience? Why do they rise? To what extent are they capable of distinguishing flies or other bait? Why are there often two types of trout in the same water? These and other problems that have been pondered by fishermen since first a fly was cast or a minnow spun, are treated in an engaging manner which never becomes tedious or didactic, although the opinions put forward are well documented by footnotes. The pure dry-fly man comes in for some delightful gibes, but they are always kindly and never sneering. It is just the book for the fisherman to take with him on his trip, for he will find in it much food for thought and new side-lights on old problems.

# Review of Biochemistry

**Handbuch der Biochemie des Menschen und der Tiere**

Herausgegeben von Prof. Dr. Carl Oppenheimer. Zweite Auflage. Ergänzungswerk, Band 3. Pp. xxiv+1162. (Jena: Gustav Fischer, 1936.) 84 gold marks.

In previous reviews of this Brobdingnagian offspring (see NATURE, 133, 595; 1934; and 135, 287; 1935) we have already commented on its dimensions and the deducible dimensions of its parent. In this third volume of the "Ergänzungswerk" to the second edition of the "Handbuch" we have 1,136 pages of text and 25 pages of index, giving a total almost identical with that of the first volume; this was, however, published in two half-volumes of about 600 pages each, and there is no clue to the reason for the production of this monster between a single pair of covers.

This third volume is supplementary to vols. 7–9 (Parts 8–10) of the main volume. It covers metabolism under special conditions, including the processes of birds, cold-blooded animals, and invertebrates; metabolism under physiological conditions, including growth, pregnancy, heavy labour, hunger and under-nutrition, variations of climate, and radiation; metabolism under the influence of secretions and of endocrine disturbances; metabolism under various pathological conditions, including fevers, nervous disturbances and deficiency diseases; and the metabolism of the female generative system. These various sections constitute the supplementary material to Part 8 of the main volume.

The supplementary material to Part 9 is concerned chiefly with the metabolism of particular organs and tissues, including tumour tissue, and with the metabolism of the various essential food constituents, water, minerals, carbohydrates, proteins, creatine and creatinine, nucleides, fats and lipoids. Part 10 is supplemented by a survey of all those subjects that are comprised under the general phrase "Regulation of Function"—including both non-specific (for example, nervous) and specific regulation, as by vitamins and hormones. The section here on the biochemistry of the sexual hormones is, incidentally, described in a note as itself supplementing Dr. Butenandt's contribution to the first supplementary volume, published in 1933—a clear demonstration of the exceptionally rapid progress now being made in the field. Separate sections in the supplement to Part 10 are devoted to the physiology of the various endocrine organs. Finally, there is a useful addendum on the sterols, bile acids, and inositol.

As in the previous supplementary volumes, the names of many of the contributors are biochemical household words. Avon, Krüger, Lehmann, Pincussen, Felix, Fürth, Grafe are among the professorial contributors, supported by a number of *Privat-Dozenten* to a total of some twenty. This volume completes the task of supplementing the "Handbuch's" second edition. It maintains the authoritative character of the other two volumes and constitutes with them a quite indispensable whole.

Words almost fail one at the scope and completeness of the "Handbuch" and the supplementary volumes. If a reviewer may be permitted to repeat himself, it can once more be stated that "these volumes are of the kind that fill the user with awe-inspired gratitude and the reviewer with awe-inspired terror". A. L. BACHARACH.

**A Pilgrim's Quest for the Divine**
By Lord Conway of Allington. Pp. 255. (London: Frederick Muller, Ltd., 1936.) 10*s*. 6*d*. net.

LORD CONWAY'S book reminds one of a philosophical romance such as "Rasselas", or even "John Inglesant". Much of it is in dialogue, and the scene passes from place to place—Switzerland, Italy, the Andes, Spitsbergen. The writer has been a pilgrim in the physical as well as in the spiritual sense. This is not a systematic treatise; but readers can go on with interest, and take the ideas as they come—they are always suggestive and often ingenious. Not that it is a casual book, for it has been rewritten four times, the author tells us, and he is working out his point of view all the while.

The problem with which the book is largely concerned is that of time and its relation to eternity, especially in the light of the theory that time is a fourth dimension of space. Lord Conway asks whether this conception may not "involve an entire revolution in our ideas about both the present and a possible so-called future life". His theory is that we are living and active in a three-dimensional state which exists within a four-dimensional universe. As we pass through the latter (as a two-dimensional inhabitant of Flat-land might pass through our three-dimensional world), "we leave behind us in what we regard as the passage of time the result of our actions built into the structure of our lives". This enables Lord Conway to envisage something in the nature of the Pauline conception of a "spiritual body", built up by a life's activities much in the way that a crystal is built up.

The last pages of the book consist of extracts from a diary kept by the author while staying with a small Franciscan community on an island near Venice. These are of particular interest, and the author seems to plead for something in the nature of a modern Third Order of St. Francis.

"After all, St. Francis was not a mere visionary but a practical reformer. Why should not practical men of our day take up his work in a new form suitable for our present needs? Has not the passion for worm-eaten speculation yet made victims enough?"

The reader must come to this somewhat unconventional book with a sympathetic mind; but if he does so, he will find it very fruitful, even fascinating.

J. C. H.

**Bibliographia Coleopterologica**
Pp. xv+149–323. (Den Haag: W. Junk, 1935.) 10*s*.

THIS publication is a special cloth-bound catalogue issued by the well-known entomological publisher, Herr W. Junk, now of The Hague. While, in principle, it is a priced list of books, reprints and journals, bearing, in the main, upon insects of the order Coleoptera, in reality it serves a much wider purpose. It is, in fact, a partial bibliography of the order, which is accompanied by a most useful index, so arranged with cross-references that publications on practically every aspect of the order can be readily found. It is intended also to serve the purpose of marking the jubilee of Herr Junk's most famous publication, the "Coleopterorum Catalogus", which was begun in the year 1910.

An interesting preface by S. Schenkling discusses the origin, history and purpose of this great work. The "Catalogus", which is now nearing completion, is the largest single work ever published dealing with the literature of any section of biology. It lists all the described species of beetles of the world, and the 141 parts (in twenty-one volumes), published to date, comprise 21,000 pages, containing the names, synonymy, distribution and taxonomic and biological literature of some 175,666 species. When completed, it will be comprised in thirty volumes, listing about 240,000 species in 134 families. The necessity for a reference work of this kind is borne out by the fact that its precursor—the Catalogue of Gimminger and Harold (1868–1876)—listed only 77,000 species.

**A Comprehensive Treatise on Inorganic and Theoretical Chemistry**
By Dr. J. W. Mellor. Vol. 15: Ni, Ru, Rh, Pd, Os, Ir. Pp. viii+816. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 63*s*. net.

VOL. 15 of "Mellor" includes nickel and five out of six elements of the platinum group. Only platinum itself remains, with a general index, to complete the final volume, which is described as "in the press". As the author's huge task approaches completion, the admiration called forth by its monumental character increases to a climax. For example, the reviewer was surprised to find his own name cited under nickel as joint author of a paper in which he himself had forgotten that this element was investigated. Such a thorough scouring of the literature can leave very few gaps to be filled up, and provides a wonderful guide to all the work done up to the date of compilation of the volume in question.

As in previous volumes, the dictionary aspect is relieved by occasional discussions, for example, on the atomic weight and valency of osmium, with special reference to the formulation of the tetroxide.

At this stage, no further commendation is needed, since in a short time the present notice will give place to congratulations when the final volume appears.

**Einführung in die angewandte Akustik:**
insbesondere in die neueren Probleme der Schallmessung, Schallübertragung und Schallaufzeichnung. Von Dr. H. J. von Braunmühl und Walter Weber. Pp. v+216. (Leipzig: S. Hirzel, 1936.) 9.20 gold marks.

FROM the physics point of view, this text is admirable. It covers most of the important applications of acoustics in the field of electrical communication, amongst which may be mentioned the measurement of performance of loudspeakers and microphones, the recording and reproduction of sound in its varied forms, acoustic perspective and the technical acoustics of enclosures. The last chapter appropriately deals with the measurement of fidelity of speech in communication systems, but the more difficult problem of measuring the fidelity in musical reproduction is not discussed.

L. E. C. H.

# Polarization of Light and some Technical Applications

By Prof. A. F. C. Pollard

WHATEVER may be the nature of light, it is convenient to regard it as the propagation of an electro-magnetic disturbance in the ether. In an isotropic medium, free of electric charge, the electric and magnetic vectors are perpendicular to one another and to the direction of propagation. Either of these may be selected as the periodic vector—the light vector—associated with the disturbance, but it is usual to define the plane of polarization as that containing the magnetic force with the electric force perpendicular to it.

There are three fundamental qualities which are of major importance to the control of light.

The wave-length, which determines the frequency or colour and the amplitude upon which the intensity of light depends, are two of these qualities which have been under almost unlimited control for centuries. But the third—the direction and type of the transverse vibration—has continued to be under very limited control up to the present time only since 1669 when Erasmus Bartholinus observed the double-refraction of Iceland spar. A few years after the publication of Bartholinus's work, Huyghens indicated the distinctive character of the two beams transmitted by the spar, and Newton's discussion on the two-sidedness of the beams led to their subsequent description as polarized light. Curiously enough, this great discovery lay dormant as an isolated fact in science until about 1808, when Malus accidentally observed that the light reflected from the glass windows of the Luxembourg palace in Paris was polarized. Biot, making use of Malus's discovery, constructed his reflecting polariscope, which was one of the first devices to produce polarized light somewhat inefficiently by reflection.

It was not until 1828, however, that the optical anisotropy of Iceland spar was utilized by William Nicol as an efficient means for producing a plane polarized beam of light. With his famous prism, one of the beams—the ordinary ray—is shunted to one side, whilst the other—the extraordinary ray—is transmitted with but slight absorption as a pencil of wholly polarized light.

The working aperture of Nicol's prism, however, is limited by the size of optically perfect crystals of the spar, and the largest which has been made has an aperture of about 4 inches. Usually, nicols are much smaller than this, and even moderately sized optically perfect crystals of the spar have already become scarce.

Commencing with Foucault in 1857 a number of investigators—Dove, Hartnack and Prazmouski, Jamin, Glan, Feussner, Zenker, Abbe, Ahrens, Silvanus Thompson and others—have devised various prisms with the object of taking every advantage to increase the aperture and economize the precious spar.

Nothing has yet been devised which equals the nicol for transparency and for the perfection of the polarization of the transmitted light; but when large apertures are required the only alternative has been the reflecting polarizer, which produces an imperfectly polarized beam with much loss of light. The recent work of E. H. Land, who makes use of the dichroic properties of certain substances, has, however, resulted in simple means for filtering out of common light a component with high percentage plane polarization by transmission through any sized aperture desired.

To understand Land's invention fully, it must be remembered that optical anisotropy may be manifest as double refraction in which the ordinary and extraordinary rays are transmitted with unequal absorption, when the difference of the coefficients of absorption may be called true dichroism.

The decrease in the intensity of the light when passing through an optically anisotropic plate may be partly due to scatter and partly due to true absorption. The difference of the coefficients of scattering is called 'dityndallism', and this with the true dichroism makes up the total dichroism. In most crystalline substances the dityndallism is negligible, but in colloidal anisotropic systems it may be important.

The absorption depends not only upon the thickness of the plate but also upon the wavelength, and consequently in nearly all dichroic crystals the transmitted light is coloured. The outstanding and historical example of a dichroic uniaxial crystal, in which the transmitted light is strongly polarized and nearly colourless, is tourmaline. In certain tourmalines the ordinary ray is completely absorbed, but the extraordinary ray vibrating in a plane parallel to the trigonal axis is transmitted unfortunately with so much absorption as to render most good polarizing tourmalines useless in feeble illumination.

In 1851 Dr. William Bird Herapath[1] discovered a remarkable compound of iodine and quinine sulphate, iodosulphate of quinine, $4Qu.3H_2SO_4.2HI.I_4.6H_2O$, which aroused great interest at the time and was afterwards called Herapathite by Haidinger. Later, he discovered a similar dichroic compound of strychnine.

The double refracting Herapathite can be crystallized in minute hexagonal plates, and it has been stated that such a plate 1/200 inch thick will completely absorb one of the rays, permitting the other to be transmitted with scarcely perceptible absorption. Large crystals cannot be made, though some were made large enough by Dr. Herapath to be used by Beale as polarizing components in the microscope[2]. These crystals were used for the microscope very shortly after their discovery, but their permanence could not be depended upon[3]. If exposed to the air or mounted in Canada balsam dissolved in xylol, the iodine disappears and the crystals lose their polarizing properties. They can be preserved, however, in Canada balsam dissolved in ether.

I have succeeded in making crystals 2–3 mm. in diameter, but they were not flat and far too friable to be ground into parallel plates.

Dr. Herapath's arresting discovery seems to have passed into oblivion until Land succeeded in making a thin sheet of nitrocellulose packed with ultra-microscopic crystals of Herapathite with their optic axes all parallel to one another. Such a sheet behaves like a single extended crystal, with the difference that since the crystalline particles overlap in the direction of the thickness of the film the transmitted beam is absorbed more than it would be in a single crystal and the sheets have a smoky brown appearance.

In his patent specification[4], Land describes processes by which these sheets may be made. One way is to prepare a gel-like mass containing Herapathite which is thoroughly mixed with a viscous nitrocellulose or cellulose acetate solution. Since the particles are asymmetrical, they will orient themselves in the same direction when the viscous mass is extruded through a slit-like die. But the retarded flow of the outer surfaces of the material during its passage through the die as compared with the flow of deeper layers will give rise to surface shear upsetting the regular arrangement of the crystals. To overcome this difficulty a layer of the charged plastic is placed between two layers of uncharged plastic before extrusion through the die. The middle charged layer then flows with practically uniform velocity over the cross section and the particles are uniformly distributed parallel to one another.

Another method is to place the viscous polarizing material in contact with a substratum of viscous non-polarizing material, such as fluid celluloid or other colourless oily ester, spread upon a glass plate or sheet of celluloid in such a way as to stretch the polarizing medium. Orientation of the particles may also be brought about by subjecting a diluted colloidal suspension to an electric or magnetic field during the setting of the mass.

It is by some such means described by Land that the Polaroid Corporation of Boston, U.S.A., has succeeded in manufacturing the 'Polaroid' sheets of polarizing material now on the market. Other firms have secured the right to employ the material in special applications. Thus, one firm supplies Polaroid analysers and polarizers for the microscope, as well as for projecting lanterns and other instruments. Another manufactures ophthalmic instruments employing Polaroid. The Eastman Kodak Co. employs the material for photographic purposes under the trade name of 'Pola Screen'; the Royal Photographic Society has awarded the Hood Medal to Mr. Edwin H. Land for his meritorious invention.

There are two grades of Pola screen at present available—Types I and II. Type I consists of sheet material cemented between glass plates of *A* or *B* quality intended for use over the camera lens. The *A* quality glass plates are optical flats hand surfaced of the highest quality, and the *B* plates are of optical glass of good quality which will not affect definition. The plates are mounted in light metal circular rims with an aperture up to 4½ inches. Similar screens with Bakelite rims are also supplied in Great Britain by Polarizers Ltd. Type II is intended for use over light sources and consists of a Polaroid sheet cemented to a single plate of glass. In this form the polarizer slightly diffuses the incident light, but may be had in sheets up to 12 inches square. The amount of polarization by single plates of Polaroid and the transmission of ordinary light through two films parallel and crossed as well as two plates parallel and crossed has been determined by L. R. Ingersoll, J. G. Winans and E. H. Krause[5] for wave-lengths 4000A. to 20,000A. and by J. Strong[6] for wave-lengths 3000A. to 11,000A.

As the behaviour of this new material cannot be judged without some knowledge of such measurements, the following table gives the average figures taken from the curves obtained by these authors. There appears to be some variance with different samples.

The dichroic properties of the material can be plainly seen by the smaller percentage of polarized light in the violet and red ends of the spectrum as compared with the intermediate portions where the absorption of one ray is almost complete. Consequently when a bright light is observed

through two crossed plates, it is seen to be coloured a deep red.

The transparency of films and plates to ordinary light is also not without interest. The material is opaque to the ultra-violet but very transparent to the infra-red, when parallel or crossed ; so that a pair of crossed films will serve as an excellent infra-red filter and will not polarize the transmitted radiation. The transparency of films in the visible spectrum is not so great as that of plates, due apparently to greater scatter, but of course the glass in the plates absorbs a large percentage of the infra-red.

| | Percentage Polarization | Percentage Transmission | | | |
|---|---|---|---|---|---|
| | | Films | | Plates | |
| | | Parallel | Crossed | Parallel | Crossed |
| 3000A. | — | 0 | 0 | 0 | 0 |
| 4000 | 70 | 1·5 | 0 | 22 | 5 |
| 4500 | 70 | 12 | 0·5 | 28 | 4 |
| 5000 | 95 | 13 | 0 | 32 | 3 |
| 5500 | 98 | 15 | 0 | 33 | 2·5 |
| 6000 | 98 | 16 | 0 | 33 | 2·5 |
| 6500 | 96 | 25 | 0 | 33 | 2·5 |
| 7000 | 91 | 34 | 2·5 | 32 | 2 |
| 8000 | 32 | 63 | 62 | 28 | 5 |
| 9000 | 9 | 77 | 77 | 37 | 29 |
| 1 μ | 5 | 85 | 85 | 39 | 43 |
| 1·1 μ | — | 85 | 85 | 41 | 41 |
| 1·5 μ | 1 | — | — | — | — |
| 2·0 μ | 0·5 | — | — | — | — |

In a subsequent patent specification[6], Land describes the use and preparation of films of nitrocellulose containing polarizing ultra-microscopic particles of inorganic periodides, particularly purpureocobaltchloridesulphateperiodide. He states that films prepared with particles of this substance, suitably oriented, give complete polarization, with a colourless transmitted beam and extremely small loss by absorption. The material should be a great improvement on the Herapathite material.

The scientific and technical applications of Polaroid are almost unlimited. The most obvious and most important application which first springs to the mind and which is specifically mentioned by Land in his first patent specification is to the vexed problem of glare from the headlights of motor vehicles. By covering the aperture of the head lamps with Polaroid with its plane of polarization in a specified position, parallel say to the vertical plane, then an observer looking through a Polaroid screen with its plane of polarization parallel to the horizontal plane will see the head lamp merely as a faint dark red source, but all objects illuminated by the headlight will be seen almost as clearly as without the screen. The light from the head lamp is polarized with its intensity reduced by a little more than fifty per cent, but this polarized light is depolarized into ordinary light when diffusely reflected from the surfaces of objects, the visibility of which is therefore unimpaired by the observer's crossed screen.

To be effective as an anti-glare device on the road, it would be necessary to enforce the use and the manner of using this material by legislation. But it is not manufactured in Great Britain, and, moreover, the patent rights are in the hands of one body which is very much alive to the immense value of this epochal invention.

Since ordinary light when specularly reflected from non-metallic surfaces at about 32° to 37° to the surface is strongly polarized in the plane of incidence, that is, the vibrations are parallel to the surface, it will be absorbed by transmission through a Polaroid film with its plane of polarization parallel to the surface. Consequently the details of reflecting objects can be seen more clearly through Polaroid films and are invaluable in photographic work. A Pola screen placed in front of the lens of a camera will enable otherwise impossible photographs to be taken obliquely through glass or water. Oblique reflections which hide surface detail or interfere with good composition can be subdued.

A single screen used in the form of spectacles will give the observer all the above advantages and aid his view of glazed pictures obstructed by surface reflections in picture galleries. But such spectacles will not cut out effectively the surface glare of roads from the setting sun which is so troublesome when motoring, since such oblique reflections are scarcely polarized.

If, however, a second screen adjustable by rotation is used in the spectacles a variable anti-glare goggle is at once available, and has been described by E. H. Land in a patent specification[7]. The screens arranged in this way can be used as a practically neutral variable density device of great simplicity and utility in many applications. The light scattered from the blue sky in and about a plane perpendicular to the sun's rays is strongly polarized in the plane containing the sun and the ray from the sky. Consequently the tone of a clear blue sky in a direction perpendicular to the sun's rays can be varied in photography from light to very dark by rotation of a Pola-screen placed in front of the lens, and surrounding objects can be made to stand out in a remarkable manner.

When the illumination is plane polarized by placing a Pola screen type II over the light source, various useful effects can be obtained by observation or photography through a second screen. Though polarized light becomes ordinary light when diffusely reflected, it retains its polarization when specularly reflected from non-metallic surfaces, and troublesome reflections can be cut out by the second screen.

Reflection from metallic surfaces, however, is more complicated. Common light is only partially polarized by metallic reflection, and plane polarized light is reflected as such only when the plane of polarization is in or perpendicular to the plane of incidence. At all other azimuths, plane polarized light is converted into elliptically polarized light by metallic reflection and so the second screen cannot completely cut out such reflections.

The advantage of polarized illumination depends upon the fact that specular reflections can be quenched by the second screen but reflections depolarized by scatter pass through it. When semi-transparent objects are examined or photographed in polarized light, the surface specular reflections can be quenched, but the light diffused from deeper layers passes the second screen and such objects assume a new appearance. Thus the true texture of the skin becomes more apparent, when the illumination is intense.

It has been stated that stereoscopic cinema projection was demonstrated by the inventor of Polaroid in New York a short time ago. For this purpose the two stereoscopic film pictures are projected on to the same screen one over the other, through Polaroid plates with their planes of polarization set at right angles to one another. The audience were supplied with Polaroid spectacles with the plate over the left eye set to cut out the right-eye picture and that over the right eye set to cut out the left-eye picture. But the nature of the projection screen surface has not been disclosed. The usual interference colour effects produced by introducing plates of uniaxial crystals or substances such as Cellophane which behave optically like uniaxial crystals, between two crossed Polaroid screens, might be used for the projection of coloured backgrounds of changing hue on the stage.

The Polaroid screen will also find many scientific uses, more particularly if the somewhat fanciful prices at present demanded are very considerably reduced when mass production starts. It cannot replace the nicol in measuring instruments in which the polarization of the light must be complete, but obviously it can be used with great advantage in photo-elastic apparatus, strain viewers, and projecting lanterns, microscopes, telescopes, ophthalmic instruments in which the nicol restricts the aperture or interferes with the definition of the optical image.

Now that E. H. Land has so successfully demonstrated the possibility of manufacturing polarizing screens, without doubt attention will be concentrated upon the production of more transparent material, transmitting a higher percentage of plane polarized light uniformly throughout the visible spectrum. It would seem that when the remarkable phenomena of photoanisotropy observed by Weigert and by Zocher and Coper in recent years are more fully understood, means will be found by which we may completely control the production of plane, circularly or even elliptically polarized light.

Weigert discovered that plane polarized light may turn an isotropic solid colloidal system into an anisotropic one with double refracting and dichroic properties. By exposing a dry layer of silver chloride suspended in gelatine to common light a bluish-red photochloride is formed. If now the photochloride is exposed to intense polarized red light the photochloride becomes double refracting and dichroic, with the plane of polarization parallel to that of the exciting light. Violet or ultra-violet light has no such effect, neither does the photoanisotropy develop at very low temperatures. Werner and Kuhn have found also that photoanisotropy is produced in an aqueous gel of the dyestuff cotton yellow when excited by plane polarized light.

But Zocher and Coper have found that circularly polarized light will convert thin photochloride layers prepared by chlorinating silver mirrors into layers exhibiting circular dichroism and circular double refraction. The circular dichroism produced is of the same sign as the dichroism produced by plane polarization. That is to say, the photoanisotropic layer is more transparent to circularly polarized light of the same sense as the exciting red light than to circularly polarized light of the opposite sense.

Circular double refraction in which the circularly polarized wave of one sense is retarded relatively to the wave of the opposite sense of rotation is simply optical activity, and this is the first case in which optical activity has been produced by light itself.

For those who are not fully acquainted with these interesting and important investigations on photoanisotropy it might be mentioned that a brief and lucid description of them has been given by Prof. H. Freundlich[8], with an extensive bibliography.

[1] *Phil. Mag.*, 3, 161 (1852); 6, 346 (1853); 7, 352 (1854); 9, 366 (1855).

[2] "How to Work with the Microscope", by Lionel S. Beale. 5th edn., 1880, p. 23.

[3] "The Microscope and its Revelations", by William B. Carpenter. 2nd edn., 1857, pp. 127, 128.

[4] British Patent No. 412,179. Dec. 16, 1932.

[5] *J. Opt. Soc. Amer.*, 26, p. 238 and p. 256 (1936).

[6] British Patent No. 433,455. Jan. 15, 1934.

[7] British Patent No. 442,825. June 17, 1935.

[8] *Photographic J.*, 76, 295 (1936).

# Tree-Ring Chronology in American Prehistory

AN *archæological reconnaissance in 1920 of the* Chaco Canyon, New Mexico, on behalf of the National Geographic Society of Washington, D.C., was followed by the decision of that Society to assume responsibility for the exploration of the two prehistoric sites of Pueblo Benito and Pueblo del Arroyo. Of these, the former is the most famous and important of the prehistoric remains of the south-western United States, the ruined structure consisting of a thousand rooms of stone and adobe. Its size alone bears out the evidence of the numerous ruined pueblos immediately adjacent that this now arid area once supported a large and densely concentrated population.

The investigations of the National Geographic Society were under the field direction of Dr. Niel M. Judd. They were carried out by successive annual expeditions in the period 1921–27. In addition to the exploration of the two villages, which were the main objective, observations were made on more than forty other sites in this important archæological area. The purpose of the expedition was not merely the study of the distinctive culture of Bonitian civilization, but also to determine as closely as possible the conditions which had led to the remarkable concentration of population and efflorescence of culture at this point, and above all, the causes of the decay of this civilization before the advent of the Spaniard to the American continent.

An investigation, which began more or less as a sideline, eventually produced a result of far-reaching importance for American archæology, of which the end is not yet in sight. This was the application of the tree-ring method of dating to the chronological problem of Pueblo Bonito and other related prehistoric remains of this region.

When the expedition of the National Geographic Society in the Chaco Canyon area came to an end in 1927, it was intended to issue a comprehensive account of the exploration as a whole; but owing to a variety of circumstances this project has had to be abandoned. The results of the expedition and the reports of those who have co-operated in the work, therefore, will appear in a series of independent papers to be known collectively as the Pueblo Bonito Series. Of these, the first, by Dr. A. E. Douglass, on the dating of the ruins by the study of tree-rings shown in the timbers of the buildings, is now available.*

* National Geographic Society. Contributed Technical Papers, Pueblo Bonito Series, No. 1: Dating Pueblo Bonito and other Ruins of the South-West. By A. E. Douglass. Pp. 74. (Washington, D.C.: National Geographical Society, 1935.)

The Pueblo Bonito Expedition first made contact with Dr. Douglass in 1921, when samples of timbers obtained in the first year of the expedition were submitted to him for examination; but it was not until the following year that intensive application of the method was made to the chronological problem at this ruin. Dr. Douglass, when engaged in an attempt to correlate climatic conditions with the periodic recurrence of sunspot activity through the study of tree-ring growth in northern Arizona, had been invited, in 1918, by Dr. Clark Wissler, of the American Museum of Natural History, to attempt a determination by this method of the comparative ages of the ruins of Aztec and Pueblo Bonito. His attention was thus directed to the possibility of dating prehistoric remains by the study of beams of timber surviving in the numerous ruins of the south-west, which presumably had been subject to like climatic conditions, and of constructing from this evidence the beginnings of a time-scale. When the operations at Pueblo Bonito came to an end in 1927, the dating of the ruin had not been determined to his complete satisfaction, and the second beam expedition of 1928—the first expedition took place in 1923—was followed by a third expedition in 1929. By this expedition what had appeared a gap in the evidence was successfully eliminated.

The tree-ring method of dating elaborated by Dr. Douglass is sufficiently well known by now to obviate detailed description. The essential feature is the identification in borings or sections of timber of certain distinctive sequence groups of the ring-growth of the tree due to the influence of an identical annual succession of variation in climatic conditions. Although some thousands of specimens have been examined, no sequence has been found to be exactly duplicated in the course of a period of more than twelve hundred years. By means of the overlap in ring growth in timber at different stages of age at given points in time, it has been possible to build up a time-scale, which proceeds from living trees to historic timbers, namely, beams from buildings of known date, and from historic to prehistoric. Dr. Douglass here figures a complete series of ring growths, which extends from 1929 right back to A.D. 698. The woods which have been found best for the purpose of the investigation are the western yellow pine (*Pinus ponderosa*) and the Douglas fir (*Pseudotsuga taxifolia*), while the next best is the pinyon (*Pinus edulis*).

This elaborated time-scale has been applied to determining the age of a large number of ruins which have furnished the material from which it has been built up; but perhaps of even greater interest for the archæologist than the dating of individual structures is the precision given to the cultural periods, of which the time relation had been determined previously by archæological methods. For example, the beautiful cream-coloured Hopi ware is seen to begin in the early part of the fourteenth century, the polychrome red pottery largely filled the thirteenth, red pottery was common in the twelfth, and black-on-white ware was characteristic of the tenth and eleventh centuries. In more general terms, of the succession of cultural periods into which archæologists have classified Pueblo civilization, Pueblo III, the golden age of south-western prehistory, took its early form in Chaco Canyon about A.D. 919, reached its local climax in the late eleventh century, and probably closed with the great drought which endured from 1276 until 1299. Pueblo IV began in the early thirteen hundreds. Dating, however, is complicated by the problem of centrifugal diffusion. Pueblo culture, it is thought, probably originated at a single centre, from which it spread outwards. It is not, therefore, everywhere contemporaneous.

So far as the dating of individual ruins is concerned, Pueblo Bonito is now shown to be the oldest of the south-western ruins. Its building began in A.D. 919, and the major construction took place in the decade 1060–70, with a lesser activity twenty years later. The important site of Aztec, notwithstanding its size, was built in a period of twelve years 1110–21. The dates determined for the beginning of construction on forty-five sites range from A.D. 919 until 1417, except for two instances, dated at 1550 and 1770 respectively.

The investigation has thrown light on a number of collateral problems. For example, there is the question of the former existence in this area of considerable pine forests, which have now disappeared, and by their extinction, no doubt, contributed their share to the aridity of the area. Some specimens which have been examined were evidently dead wood at the time they were used, and the confused and almost indistinguishable rings at the end of their growth bear witness to the aridity which caused their death. This formation has been paralleled from trees which have died recently.

The evidence of the grouping of sequences of poor growth is interpreted as pointing to a succession of droughts, which recurred with extreme severity at intervals of about three hundred years. One of these droughts, the most severe, covered the closing years of the thirteenth century (1276–99); another appears from 1573 until 1593; and still another in 1890, with a period of maximum intensity from 1896 until 1904. Periods of drought earlier than these are also perceptible, which go back so far as A.D. 904. The study of these cycles should prove of importance for the future of climatology. Archæologists will look forward with keenest anticipation to the extension of this technique to conditions which will throw light on the beginnings of Pueblo culture and its dating in relation to the culture of the Basket-makers.

# Obituary

## Mr. R. D. Oldham, F.R.S.

RICHARD DIXON OLDHAM, whose death took place at Llandrindod Wells on July 15, was an original and independent thinker—a little too independent sometimes for those in authority. He was most widely known for his geological work in India and his seismological investigations; but he wrote on other subjects, and his writings are always interesting and suggestive. He was the third son of Dr. Thomas Oldham, F.R.S., the first director of the Geological Survey of India, and was born on July 31, 1858. He was educated at Rugby and the Royal School of Mines, and appears to have been elected to a science scholarship at Emmanuel College, Cambridge, but never took it up. His father, who had retired two years earlier, died in 1878; and he, following his father's footsteps, accepted an appointment on the Indian Geological Survey in 1879.

In the regular fieldwork of the Survey, Oldham had a wide and varied experience, chiefly in the north, ranging from Manipur to Baluchistan; and he also visited the Andaman Islands. The results are to be found in many papers in the "Memoirs" and "Records" of the Survey. In addition to his fieldwork, he edited his father's unpublished papers on earthquakes and thermal springs in India. The most important of these dealt with the Cachar earthquake of 1869, and the editing included the whole of the discussion of the observations collected by his father, a very useful grounding for his later work in seismology. He also compiled a "Bibliography of Indian Geology" (1888), and prepared the second edition of the official "Manual of the Geology of India" (1893). This was essentially a new work, though it incorporated much of the original edition; and several of the new chapters written by Oldham are of great

interest to all geologists, not only to those in India. But perhaps his most important work for the Survey was the "Report on the Great Earthquake of 12th June 1897", forming vol. 29 of the "Memoirs" (1900). Seismology was now his chief interest. He was the first to show (*Phil. Trans.*, A, **194**, 135) that the disturbance set up by a great earthquake splits into three distinct forms of wave-motion which, travelling at different rates and along different paths, give rise to the three distinct phases observed in distant seismographic records.

Oldham retired from the Survey in 1903, and for some time lived in the Isle of Wight, where he was near the seismographic station of his great friend, John Milne. His seismological studies were continued; in 1906 he showed that the records of distant earthquakes indicate that the earth has a core very different in properties from the rest, and he determined its diameter approximately. He was indeed a pioneer in the application of seismology to the investigation of the interior of the earth.

In his later years, Oldham spent much time in the south of France, where he studied the history of the Rhône delta, and finally he withdrew to Llandrindod Wells.

Oldham was awarded the Lyell Medal of the Geological Society in 1908, and was president of that Society in 1920–22. He was elected a fellow of the Royal Society in 1911. P. L.

## Prof. Snouck Hurgronje

We regret to record the death of Prof. Christian Snouck Hurgronje of Leyden, the distinguished authority on the religion and customs of Islam, which took place on June 26 at the age of eighty-one years.

Prof. Hurgronje was not only one of the foremost oriental scholars of his time, but he was also a great exponent of the value in affairs of the study of living native institutions, his intimate knowledge of the languages of the East and of the customs, religion and laws of Islam having proved of signal service to the Colonial Government during his residence in the Dutch East Indies.

Hurgronje was born in 1855; and in 1885 was admitted by the University of Leyden to the degree of doctor in Semitic languages and literature for a dissertation on the Feast of Mecca. He continued his oriental studies at Strassburg, and was then appointed instructor in Arabic and the institutions of Islam at the School of Instruction for Dutch-Indian officials at Leyden. In 1884, with the object of obtaining a first-hand knowledge of the religious exercises of Islam, he went to Jiddah, the landing place of pilgrims to Mecca. Here he remained until fully equipped to enter the holy places of Mecca. This he did with pilgrims from the Dutch East Indies in February 1885, and remained in the city until the following August, living with the pilgrims and carrying out their religious observances, until the killing of the French orientalist, Dr. Huber, while trying to penetrate into the interior from Jiddah, led to his expulsion by the Turkish authorities.

In 1889, Hurgronje began his work in the Dutch East Indies, when he was sent out by the Government at The Hague to act as adviser on Moslem institutions in Java. His appointment, originally for two years only, lasted for many years, so valuable did his services prove to the Government. One of his more notable achievements was in tendering advice to the Colonial Government and the Government at The Hague, which was framed in the light of his study of Achinese institutions, and contributed largely to the pacification of northern Sumatra, where the Government had been carrying on a desultory war with the Achinese since 1873.

Although both Cambridge and Leyden had offered chairs to Hurgronje, he declined all such offers until he could regard his work in the East as completed; but he accepted the professorship of Arabic at Leyden in 1906. Here he was not forgetful of his practical experience in the East, and for the remainder of his life he continued to be a close observer of the effect of modern trends in international relations on the development of Islam, a matter upon which he produced several important and authoritative articles. He presided over the Congress of Orientalists when it met at Leyden in 1931, having also been a member of the Congress when it met previously at Leyden in 1883.

Hurgronje was the author of a large number of contributions to the literature of oriental studies. Among his best-known works are "Mekka" (1888), a study of the Achinese (1893–94), and "Une Nouvelle Biographie de Mohammed" (1894).

## Dr. F. J. F. Shaw, C.I.E.

Dr. F. J. F. Shaw, whose death in India was recently announced, joined the Indian Agricultural Service in 1910 as a mycologist attached to the Agricultural Research Institute, Pusa. He remained at Pusa for the whole of his service except for a short period at Coimbatore in Madras, and was engaged in research in plant pathology and work on the control of plant diseases until 1928, when he was appointed Imperial economic botanist. Even in this latter appointment much of his work was the breeding of crop plants for resistance to disease, so that he retained his interest in plant pathology in the broad sense. Of late, much of his time was occupied in administrative duties, for he was appointed director of the Imperial Institute of Agricultural Research at Pusa in 1934, and as such had the supervision of the arrangements for transferring the Institute, wrecked by the Bihar earthquake that year, to a new site near Delhi. For the last few months he was at Simla officiating as agricultural expert with the Imperial Council of Agricultural Research; but he left to supervise some of the difficult operations of the transfer of the Institute, and was overcome by the heat at Agra.

Dr. Shaw was best known for his researches on the important fungal parasites of Indian crops belonging to the genus *Rhizoctonia*, and for his studies on the diseases of jute and the control of diseases of

fruit trees and pulses. He was little interested in systematic mycology, and was led astray in the identification of the difficult members of the genus *Rhizoctonia* with which he worked, but he effected a considerable advance in knowledge of their biology and morphology. Of recent years, his chief work was a study of the types of the important Indian pulse crop, pigeon pea (*Cajanus indicus*), with the object of breeding for resistance to the wilt disease caused by *Fusarium vasinfectum*; in this difficult problem, for the crop is extensively out-pollinated, he achieved a considerable measure of success. If the work can be carried to a conclusion it will be of great benefit to Indian agriculture, for the disease is extremely destructive and the parasite so completely infests the soil as to necessitate prolonged rotation if the crop is to yield an adequate harvest. Other work on similar lines has been in progress at Pusa under Dr. Shaw's control on a number of crops such as cereals, linseed, gram (*Cicer arictinum*) and other pulses, tobacco and various fibre and oil seed crops; continuity in such work is essential, and Dr. Shaw's untimely death will greatly accentuate the difficulties of carrying it on, already made serious by the aftermath of the earthquake.

Dr. Shaw, who was fifty years of age, was educated at St. Olave's Grammar School and the Royal College of Science, obtaining the A.R.C.S. and D.Sc. (London). He was made a C.I.E. in the King's birthday honours list of this year.

## Prof. Kikunaé Ikeda

By the death of Prof. Kikunaé Ikeda on May 3, Japanese science loses one of its foremost students of chemistry. Some details concerning his life and work appear in the May issue of the *Proceedings of the Imperial Academy, Tokyo*. Prof. Ikeda, who was born on October 8, 1864, studied science at the University of Tokyo and graduated in 1889. During the next seven years, he taught chemistry in the Tokyo Higher Normal School, where, both by his teaching and by the text-books that he published, he greatly assisted the general appreciation in Japan of the new science of physical chemistry.

In 1896, Ikeda was appointed assistant professor of chemistry in the University of Tokyo, in which capacity he came to Europe three years later for further study of physical chemistry. During his stay in Europe, he worked in Ostwald's laboratory, where, in collaboration with Bredig, he published important work on the poisoning of colloidal platinum catalysts. He also worked for a short time at the Davy Faraday Laboratory in London. On his return to Japan in 1901, he was appointed to a full professorship in chemistry, which he held for twenty-two years. During this time he was particularly occupied with the study of chemical kinetics and the theory of solutions. During this period he was appointed chief of the Chemistry Division of the Institute of Physical and Chemical Research, and he served also on the National Research Council of Japan.

On retiring from his professorship in 1923, Prof. Ikeda continued to take an active interest in chemistry. After a stay of seven years in Germany, he returned to Japan in 1931 and established a private laboratory where he studied various problems concerned with the applications of chemistry. The high esteem in which he was held was shown on his sixtieth birthday, when his friends and former pupils arranged a celebration and raised a large sum of money which, by his wish, was given to the Chemical Society of Japan for the extension of the scientific publications of the Society.

## Mr. F. S. Stacey

We regret to announce the death, on August 11, of Mr. Francis Samuel Stacey, one of the pioneers of radiotelegraphy, at the age of fifty-six years.

Mr. Stacey was a student of Finsbury Technical College, and joined Marconi's Wireless Telegraph Co., Ltd. (then known as The Wireless Telegraph and Signal Co., Ltd.), in July, 1899, at the age of twenty years. After a short period in the Company's works he was employed for some time in experimental work as an assistant to Marchese Marconi, and, in 1900, was engaged in the execution of a contract for the installation of wireless on the whole fleet of Belgian cross-channel steamers. Shortly afterwards he was transferred to Marconi's Wireless Telegraph Company of Canada, where he remained until 1910, engaged in the construction of stations, experimental work, and the operation of the Glace Bay trans-Atlantic wireless station.

Between 1910 and 1912 Mr. Stacey was employed at the Marconi station at Poldhu in Cornwall in connexion with experimental work and development of long-range high-power stations which had their birth at Poldhu. From 1912 until 1914 he was acting chief of the Constructional Section of the Marconi Company, and in 1914 became chief of one of the contract sections which deals with the supply of every kind of commercial wireless telegraph apparatus. Among other things, his department of the Marconi Co. has been concerned with the execution of contracts for nearly all the broadcasting stations in England, and a very large number in Europe, Japan, South Africa, and South America.

Mr. Stacey was married in 1909 to Miss M. McLeod, a Canadian lady, and leaves a widow and two daughters.

We regret to announce the following deaths:

Prof. Luigi Devoto, professor of industrial diseases and director of the clinic of industrial diseases in the University of Milan, on July 22, aged seventy-two years.

Prof. Aubrey C. Grubb, professor of physical chemistry in the University of Saskatchewan, known for his work on the electrical activation of hydrogen and nitrogen gases, on July 29, aged fifty-two years.

Dr. H. A. D. Jowett, manager of the Wellcome Chemical Works, Dartford, an authority on medicinal alkaloids, on August 10, aged sixty-six years.

# News and Views

### Jean-Baptiste-Louis Romé de l'Isle (1736–90)

AUGUST 26 is the bicentenary of the birth of Jean-Baptiste-Louis Romé de l'Isle, an assiduous student of natural history and a writer on crystallography. He was born at Gray in Haute-Saône. After being educated in Paris, he sailed to the East Indies as secretary of a company of artillery, and in 1761 became a prisoner of the English at Pondicherry, being held captive for three years. Having acquired a taste for science, on his return home he became a student of the chemist Balthasar-George Sage (1740–1824) and applied himself to mineralogy, forming a mineralogical cabinet, and in 1772 publishing his "Essai de Cristallographie". This work he afterwards enlarged and published in 1783 under the title "Cristallographie, ou Description des formes propres à tous les corps du règne mineral dans l'ètat de combinaison saline pierreuse ou métallique". It contained tables of all the crystals then known. Another subject to which he devoted much time was metrology, stimulated no doubt by the chaotic state of the weights and measures in France at the time. He collected a great mass of material relating to the subject, some of which he embodied in his "Métrologie, ou Table pour servir à l'intelligence des poids et mésures des anciens . . ." which appeared in 1789, the year the Revolution broke out. Through his close application to study he suffered somewhat from failing eyesight, and this being brought to the notice of Louis XVI, he was granted a small pension, although he had held no official position. His death took place in Paris on March 7, 1790.

### Water Resources and Supply Control

THE Parliamentary Joint Committee appointed to consider and report on measures for the better conservation and organization of water resources and supplies in England and Wales has, in its report just issued (London: H.M. Stationery Office. 3*d*. net), made some caustic comments on the attitude of the Ministry of Health towards the general aspect of the whole question of national water administration, pointing out the one-sided nature of the composition of the Advisory Committee on Water, upon the reports of which the proposals of the Ministry of Health have been framed. The Joint Committee states that it is of opinion "that the methods of the Ministry of Health justify in no small degree the criticisms that have been levelled against them by reason of their apparent failure either to consider the point of view of, or to consult with, opposing interests before submitting their proposals to the Committee". Accordingly, the Committee does not see its way to endorse the memorandum submitted by the Ministry of Health, in which it is proposed that power should be given to the Minister to make orders scheduling areas within which the conservation of surface or underground water resources for water supplies is of public interest, the object of the orders being to prevent water from being drawn from those areas for water undertakings, or for industrial or other purposes, without his consent. The evidence of witnesses who appeared before the Committee showed unmistakably the hostility of interests connected with industry, agriculture and fisheries to any such form of dictatorship in water administration, alleging the incompetence of the Ministry of Health to appreciate needs other than those which are associated with water for domestic and sanitary uses. The Committee's judgment is that all proposals for the appropriation of supply areas should remain, as heretofore, under direct parliamentary control, and it is unable to recommend any procedure other than the continuance of that by Private Bill.

### Proposed Central Advisory Water Board

THE principal constructive feature of the Joint Committee's report is its recommendation that a statutory Central Advisory Water Board should be set up, comprising representatives of the various ministries affected and other interested bodies, such as catchment and fishery boards, water undertakers and mill and riparian owners. In addition, it recommends the extension and development of the nine Regional Advisory Committees, at present in existence in various parts of the country, by the addition of three or four others, so as to cover the remaining areas, and it expresses the view that these bodies, which are purely voluntary with representation confined to water undertakers and the Ministry of Health, should be enlarged to include representatives of the catchment boards and other interests, and that they should discuss and report to the Central Advisory Water Board on any difficulties or differences and on general matters concerning their respective areas. The Central Board would collect and marshal all the available statistical data and information of the country's water resources and requirements, and advise the appropriate Minister as to the initiation of any schemes or proposals considered necessary in the public interest. The Central Board should further submit reports to all Select Committees of Parliament considering Bills on water supply, and make an annual report to be laid before both Houses of Parliament. The Joint Committee's report also deals with the question of compensation water, admittedly beset with complications, some of which are pointed out. Rejecting the formula proposed by the Ministry of Health, and indeed any formula, since no suitable formula can be found for general application, the Joint Committee concludes its report with a statement of the considerations which must apply in the assessment of compensation water, each case being, of necessity, determined on its particular merits.

**Native Medical Practitioners in the South Seas**

THE Government of Fiji recognized many years ago the need for a medical service for the native population, but realized that the employment of European doctors on a large scale was impracticable on account of cost, and that practitioners of their own race would be best suited to attend to the needs of the natives. The Government therefore established the Native School of Medicine at Suva for the benefit of Fijians, and for many years its 'graduates' did excellent work. A few years ago, the Rockefeller Foundation commenced investigations upon the problems of disease and of depopulation in these islands, and was so impressed with the success of this Native School that it offered to co-operate with the Fijian Government, and suggested the training of natives from eight groups of islands in the School at Suva. The Government agreed to work in conjunction with the Foundation, and the School was then re-organized and reconstituted in its present form. The School is residential, and is attached to the Suva Memorial Hospital. Its direction is in European hands, the students are under reasonable discipline, and the cost of maintenance is small—something less than £3,000 a year—which is contributed in various ways.

SIR JAMES BARRETT, Vice-Chancellor of the University of Melbourne, gives an account of the activities of the School in an article in the *Morning Post* of August 7. The students are mostly Polynesians, and must pass a matriculation examination before admission, based upon the New Zealand proficiency examination, which ensures a good knowledge of English. The first year of the present four-years' course is devoted to elementary basic science, and the remaining three years provide the student with a sound, practical medical training in the Suva Hospital. After graduation, the practitioners return to their own islands as health or medical officers among their own people. The initial salary of a graduate is £60 a year, rising to a maximum of £150, which suffices for local requirements. If no European doctor is available, as is often the case, the native practitioner may attend to the medical requirements of Europeans. At present, eighty-four practitioners are at work, distributed over Fiji, Samoa, Tonga, the Cook Islands, Gilbert and Ellice Islands, Solomon Islands, and New Hebrides; of these, Fiji takes fifty-six. In addition, native nurses have been trained in large numbers; the Suva Hospital is staffed by twenty European and twenty Fijian nurses, and there are forty-seven obstetric nurses in Fiji alone. Sir James Barrett endorses the very favourable opinion on the efficiency of the School and of the practitioners it has trained expressed by Profs. Wright and Buckmaster, who, having visited Australia and New Zealand on behalf of the Royal College of Surgeons of England, passed through Suva on their return journey. Sir James envisages the adoption of some such system to meet the medical needs of the natives in other parts of the British Empire, referring to the existence of somewhat similar schools already founded in West Africa and Uganda.

**The Radcliffe Observatory in South Africa**

THE 'turn-over' article in *The Times* of August 7 by Mr. H. E. Wood, the Union Astronomer, deals with astronomy in South Africa in general, and refers in particular to the forthcoming re-establishment of the Radcliffe Observatory at Pretoria. The history of astronomy in South Africa begins in 1685, when Father Tachard called at the Cape on his way to Siam and determined the longitude by observations of Jupiter's satellites. During the next century, two expeditions visited the Cape, and 1820 saw the foundation of the Royal Observatory, which has made such notable contributions to our knowledge of the southern stars. In 1834 Sir John Herschel landed there and made his famous catalogues of nebulæ and double stars. There are now four other observatories in South Africa: the Union Observatory and the southern station of Yale University Observatory at Johannesburg, and those of Harvard and Michigan at Bloomfontein. The Radcliffe Observatory, for more than a hundred and sixty years at Oxford, will, it is hoped, have started its new life at Pretoria within the next two years. Good progress is being made with the construction of its 74-inch reflector by Sir Howard Grubb, Parsons and Co. This will differ in several respects from its sister telescope at Toronto, as it will have, in addition to facilities for observation at the Newtonian and Cassegrain focuses, an arrangement for sending the beam of light down the polar axis to a fixed spectrograph, and it will be driven by a synchronous motor, the frequency of the alternating current being controlled by a tuning fork. The disk of Pyrex glass for the large mirror has been cast by the Corning Glass Co. and is now being annealed. The five secondary mirrors will be of fused silica, and the disks for these are being made by the Thermal Syndicate, Ltd.

**Archæological Excavations in Britain**

WITH the coming of university and school vacations, numbers of voluntary workers are released for archæological investigations in the field. Since July, excavations have been resumed or initiated on many sites in Britain. The scheme of training in field work through voluntary assistance organized by Dr. R. E. Mortimer and the late Mrs. Wheeler is again in being, this year on an extended scale. Nearly a hundred students drawn from universities in the British Isles, Australia, India, Canada, the United States and China are at work on the continued excavation of Maiden Castle, near Dorchester, under the direction of Dr. Wheeler and Col. C. D. Drew. Although the season has only just opened, some important results already have emerged. On the hill-top in the neighbourhood of the temple of the Roman period discovered in 1934, according to a report in *The Times* of August 14, further stone age habitations, with stone implements and pottery, have been discovered. A series of pits has been uncovered, in which were pottery and animal bones, including those of large oxen of a type now extinct. The neolithic site underlying the fortifications is also being explored. Extensive areas containing stone implements and pottery

have been opened up; and a stone age trench now being examined is found to be covered with a well-marked line of turf underlying the later prehistoric rampart. It contains large masses of material of the stone and early bronze ages, while on top of the trench numerous sherds of elaborately decorated Early Bronze Age pottery are being identified.

EXCAVATIONS have also been resumed on behalf of the Ipswich Museum under the direction of the curator, Mr. Guy Maynard, on the Stanton Chair Farm Roman site between Ixworth and Stanton in Suffolk, where investigations were initiated last autumn as a result of the observation of Roman potsherds and tile fragments in a field. Although it is known that the area of the site is at least two hundred feet across, operations at present are confined to a narrow strip, as the ground is under crops. Work, accordingly, has been concentrated on clearing the remains of a bath-house, of which the hypocaust pillars are well preserved, and a drain from the cement floor of an adjacent room still remains. Two levels of flooring and coins of Marcus Aurelius (A.D. 161–186) and Eugenius (A.D. 393) suggest a prolonged, but interrupted occupation. Six weeks of excavation at Castle Dore, an Iron Age hill-fort, near Fowey, in Cornwall, under the direction of Mr. Ralegh Radford, with the unemployed for labour, has confirmed previous conclusions as to its character. It was evidently a strong point commanding the ancient prehistoric road and trade route across the peninsula. It is now considered beyond reasonable doubt that this was, as has been suggested, the palace of the King Mark of Arthurian legend. Students of the University of Liverpool excavating, also with the assistance of local unemployed, on Eddisbury Hill, Cheshire, have brought to light traces of an ancient fortress in the form of walls of local sandstone, five to six feet in height, in an excellent state of preservation.

### Ultra-short Wave Radio Communication

THE practical application of ultra-short waves to radio communication made a step forward on June 11, when R.C.A. Communications Inc. gave a public demonstration of their new circuit connecting New York with Philadelphia. A brief illustrated description of this demonstration is given in the June issue of *Communication and Broadcast Engineering* (U.S.A.). The circuit operates over a distance of about 91 miles with the aid of two automatic relay stations situated between the terminal stations at New York and Philadelphia, the longest individual link being 36 miles. A two-way service is provided, and the six wave-lengths required are in the neighbourhood of three metres; the stations are equipped for the transmission of drawings, typescript and other visual material in facsimile, with simultaneous operation of typewriter and telegraph channels. The article referred to above includes a schematic diagram of the circuit which is reproduced from one actually transmitted to New York by the facsimile circuit. The transmitters make use of resonant line circuits in order to secure frequency stability, while the receivers incorporate the new acorn tubes specially produced for ultra-short wave purposes.

AN interesting feature of the new installation is the method by which the unattended relay stations may be turned on or off from either of the terminal stations. The receivers at each of the four stations are always alive and available for reception from their corresponding transmitters. When it is desired to make the circuit ready for traffic, New York or Philadelphia sends out a tone modulation on its carrier wave. This tone is accepted by the receiver at the first relay station, and is caused to start up its own transmitter, which then passes the tone modulation on to the second relay station. The operation is repeated here and also at the other terminal station, where the tone is re-transmitted back through the relay stations on the return circuit. Thus when the tone signal is received back at the terminal station from which it originated, it is known that all six transmitters are in operation and the radio circuit is ready to pass traffic. When the circuit is no longer required, the tone is removed and the transmitters are automatically switched off, one by one, in the same sequence.

### League of Nations Reform

IN a pamphlet entitled "Anarchy or Peace", Lord Davies discusses the dangers of the present situation in Europe and the possibilities of avoiding the outbreak of an even more disastrous European war (London: The New Commonwealth. 9*d*.). Referring to the defects of the League of Nations as demonstrated by recent events, Lord Davies asserts that these were due to the absence of an equity tribunal and international police force, and more particularly to the lack of cohesion and determination on the part of States members of the League. Accordingly, he heavily discounts a good many of the proposals to reform the League as designed rather to deprive the League of the very functions which would enable it to secure the peace of the world if its machinery were honestly and whole-heartedly used. Proposals to substitute a series of regional pacts are only too certain to plunge us back in the pre-War system with its inevitable outcome. Lord Davies argues that the only solution of our present dangerous situation lies first in the creation of peaceful procedure for the settlement of all disputes and the revision of treaties. For this purpose, in default of a more satisfactory solution, an equity tribunal holds the field. Secondly, an international police force is required, and he urges once more the equipment of a European air police force under the control and direction of a neutral authority, a reconstituted League. This force must be superior in numbers and equipment to the national air force of any European State which refuses to join in the guarantee. Only a scheme on these lines will suffice to restore the confidence of the smaller powers in the integrity and good faith of the great powers, and endow the League with the superiority of force essential for the establishment of the rule of law.

### Liverpool Learned Societies

THE newly issued handbook of the Associated Learned Societies of Liverpool and District shows there are about four thousand members of the twenty-four scientific, industrial, literary, art and educational societies in the association. One of the largest of the industrial societies, the Liverpool Engineering Society, has some seven hundred members, and the Liverpool Naturalists' Field Club is the largest of the Nature and outdoor societies. Since the last handbook was issued ten years ago, the number of learned societies in the association has fallen by two. Local societies which have increased their membership in the past ten years are the British Association of Chemists, the Institute of Chemistry and the Liverpool Naturalists' Field Club; those that have remained at the same strength include the local branch of the Pharmaceutical Society and the Amateur Photographic Association, while those that have declined in membership somewhat include the Liverpool Botanical Society, Geological Society, Biological Society, Literary and Philosophical Society, Astronomical Society, Engineering Society, Lancashire and Cheshire Entomological Society, Society of Chemical Industry and the New Education Fellowship. The Associated Learned Societies of Liverpool and District was formed in 1922, though since 1880 there had been a scheme of co-operation between local societies, chiefly for staging annual exhibitions and soirées of their activities. The work of the present association includes holiday prize contests in the local schools, outdoor and indoor joint meetings of an educational nature, periodical public scientific exhibitions, lectures, etc., and various schemes for closer co-operation amongst the various learned societies of the district.

### Research and the Jute Industry

THE prosperity of Bengal, both agricultural and industrial, is dependent very largely on jute, and the intense period of depression which has overtaken the industry since 1929 has caused widespread distress. The Agricultural Commission, of which the present Viceroy was chairman, in a strongly worded paragraph of its report, directed attention to the necessity for the application of scientific methods in the industry; the position has since been surveyed by Dr. S. G. Barker. In the March issue of *Science and Culture*, Dr. Barker's report is discussed. Dr. Barker has recommended a comprehensive scheme of research which includes the establishment of a laboratory with arrangements for the collection of general and technical information and for foreign representation. This new organization is estimated to cost £27,000 per annum, and it would be under the control of the Jute Mills Association. *Science and Culture* appears to doubt whether the control suggested by Dr. Barker is likely to prove successful, since it is feared that the mill owners may be prone to look for immediate financial returns. It is suggested that a scheme organized on the lines of the Indian Central Cotton Committee might be more advantageous. In view of the urgency of the problem, we regard the nature of the controlling body to be of minor importance, since the success of the scheme will depend mainly upon the director of research and upon the personnel of the new laboratory. It is gratifying, therefore, to learn that the Government of India has already accepted Dr. Barker's proposals, and that it has appointed an Indian Central Jute Committee. The Committee will be financed by Government, which will place at its disposal approximately £30,000 per annum for a minimum period of five years. We extend a cordial welcome to this new research organization, which we have no doubt will do much to restore the ancient prosperity of Bengal.

### Road Transport Vehicles

INSTRUCTIVE figures are given in *World Power* of June showing the relative progress made by the three principal types of road transport vehicles—tramways, motor-buses and trolley-buses. In 1930–31, tramways transported 72·7 per cent of all passengers, the motor-bus 24·2 per cent and the trolley-bus 3·1 per cent. In 1934–35 the figures were 59 per cent, 35 per cent and 6 per cent respectively. Although the tramways with 2,479 million passengers in 1934–35 still convey more persons than the motor-bus and trolley-bus combined, the decline of tramway passengers since 1930–31, when it was 3,018 millions, has been continuous. During the year 1935, the number of passengers carried by the trolley-buses was 255 millions, an increase of 36 per cent on the preceding year. The London Passenger Transport Board recently reported an increase of 20 per cent in the London area along trolley-bus routes. It has been calculated that an oil-driven bus would require a 250 horse-power engine to equal the performance of a 100 horse-power trolley-bus with a capacity of 36 seats carrying a full load up a 7 per cent gradient at a speed of 30 miles per hour. From the point of view of national economy, it is a pity, although trolley-bus progress is satisfactory, that it is not making more rapid headway. In the near future, it may be of primary importance to consume home-produced fuel to produce the necessary motive power for traction. When the traffic is very heavy, electric tramways are the most economical, but tram-cars often stop the traffic to unload passengers, whilst trolley-buses can unload them directly on the pavement.

### A Horticultural Colour Chart

THE naming of colour is notoriously difficult, and it is unfortunate that the standard works by Ridgway, Oberthur and Dauthenay, and others, are either out of print or too expensive to have wide application. Gardeners are, perhaps, the community most in need of a comprehensive manual portraying accurate shades of colour, and the Royal Horticultural Society is to be congratulated upon its attempt to meet this pressing need. It is proposed to print a volume of a hundred colours, each in four shades, and, if successful, to follow it by a second volume of similar dimensions. The plates would be either loose in a cover, or held by a loose-leaf binder, and the estimated price is 10s.

per volume. This, however, may possibly be reduced if sufficient applications follow the prospectus now issued. A specimen sheet indicates that each colour would be named, and referred also to the British Colour Council's classification, to the "Repertoire des Couleurs", and to the standards of Ridgway and Ostwald. A brief history of the name appears, horticultural examples are cited, and French, German, Italian and Spanish synonyms are given. The chart should have great utility, not only in the garden, but also wherever colours have to be compared with accuracy. A preliminary application form is now available, and those interested should communicate with the Royal Horticultural Society, Vincent Square, S.W.1. It is expected that the first volume will appear towards the end of 1936 or early in 1937.

### Medal Awards for Inventions

THE Council of the Institute of Patentees has decided to suspend the award of the Institute Bronze Medal and in place thereof to substitute the Institute's Silver Medal to rank equally with the Founder's Silver Medal. These medals will be awarded in each section of the Exhibition of Inventions to be opened in the Central Hall, Westminster, S.W.1 on September 30 and in Newcastle on November 25; therefore ten silver medals will be awarded throughout the five sub-sections of the New Inventions Section of the Exhibition. The Gold, Silver and Bronze Certificates will be awarded as in previous years. As the Institute proposes to organize a series of exhibitions throughout the country, it has been decided that the Grey-Wilson Memorial Gold Medal, supported by cash prize, together with the Yorkshire Medal, will be competed for during January of each year, the successful exhibitors at any Exhibition organized by the Institute being eligible to compete. The Yorkshire Medal is a new medal which was provided for under the will of the late Mr. Hoffman-Wood, an architect of Addingham, Yorkshire, who died three years ago, and the Institute will make recommendations annually to the trustees regarding its award. The medal is valued at twenty-five guineas, and sufficient funds are available for an award in perpetuity. The award of the Yorkshire Medal must be for an invention not relating to warfare.

### International Naval Architecture and Marine Engineering

THE first international meeting of naval architects and marine engineers to be held in the United States takes place in New York on September 14–19, at which papers will be read dealing chiefly with safety of life at sea and large Atlantic liners. The Dominion of Canada, France, Germany, Great Britain, Italy, Japan, Spain and Sweden are sending delegations at the invitation of the Society of Naval Architects and Marine Engineers of New York. The British delegation, under the leadership of Lord Stonehaven, president of the Institution of Naval Architects, and Dr. J. T. Batey, president of the North-East Coast Institution of Engineers and Shipbuilders, will number about a hundred, including ladies, and will represent the Institution of Naval Architects, the Institute of Marine Engineers, the Institution of Engineers and Shipbuilders in Scotland, and the North-East Coast Institution of Engineers and Shipbuilders.

### International Congress of the History of Science

THE fourth International Congress of the History of Science will meet in Prague, in 1937, during the last week of September. The principal theme of the Congress will be "Science in the Eighteenth Century". The chairman of the Congress and of the Organizing Committee is Prof. Quido Vetter, the actual president of the International Academy of the History of Science. The announcement was made and discussed at the meeting of the Academy of the History of Science at Cluj (Rumania) in conjunction with the International Committee of Historians, in April last. During the meeting, several papers of great interest were read: (1) A. Mieli, "Our Present Knowledge of Arabian Science"; (2) Prof. A. Reymond (Lausanne), "Occult Sciences and Exact Science in Ancient Times"; (3) Prof. A. Singh (Lucknow), "History of Trigonometry in India"; and (4) Prof. V. Bologa (Cluj), "Foreign Influences on Rumanian Medicine". In a business session of the meeting, Drs. Reymond, Ulrich, Sergescu, Singh and Greenwood read reports on the organization of the teaching of the history of science in their various countries. The "Chronological Repertory of the Exact Sciences during the Sixteenth Century" was adopted for publication as a special number of the *Bulletin du Comité des Sciences Historiques*.

### British School of Archæology at Athens

IN October next the British School of Archæology at Athens will celebrate the fiftieth anniversary of its foundation. As part of the celebration an exhibition will be held at the Royal Academy of Arts, Burlington House, London, to illustrate the discoveries in Greece and Crete, which have resulted from the work of the School. A special section of the exhibition will be devoted to the Minoan civilizations of Greece and the excavations at Knossos, which were conducted by Sir Arthur Evans, honorary student of the School, and in which the architects of the School took part. This section of the exhibition is being prepared by Sir Arthur Evans himself, with the facilities given him by the authorities of the Ashmolean Museum, Oxford, to which the antiquities brought from Knossos by Sir Arthur were entrusted. It is understood that the exhibition will be inaugurated by H.R.H. the Duke of Kent on October 13, at 3 p.m., and will be open to the public from October 14 until November 14. The occasion of the jubilee of the School will also be marked by a special fund which it is proposed to raise to enable the School to increase its staff, improve its library and accommodation, and provide for the needs of the graduates who are sent to Greece in increasing numbers for advanced study by the universities.

### Congrès Préhistorique de France

IT is announced that the twelfth session of the Congrès Préhistorique de France will be held at

Toulouse on September 13–16 and continued at Foix on September 17–20. This is the third occasion only on which the Congress has met since the Great War, the meetings, held biennially between 1905 and 1913, having been intermitted during and after the War until 1931. The coming session, which is the first to be held in the Pyrenean region, will afford members an opportunity to visit a number of famous and important archæological sites, such as Aurignac, Mas d'Azil, Marsoulas, Gargas, Niaux and Portel. Excursions to these are being arranged as part of the daily programme. As is usual in congresses of this character, a number of topics is suggested for the communications to be submitted. These include the earlier palæolithic of the area, the terraces of the Garonne and their quartzites, prehistoric art, the mesolithic and the neolithic periods, and artificial caves and subterranean refuges. Arrangements are being made by the local committees at Toulouse and Foix for a special exhibition of prehistoric finds from the excavations and collections of the archæologists of the two departments of Haute Garonne and Ariège. It is also to be noted that the Musée d'Histoire Naturelle de Toulouse has a collection of cave exhibits which is considered to be the finest in the whole of France. The Congress, of which M. le Comte H. Begouen will act as president, has the official support of the University of Toulouse, the municipal authorities of Toulouse and Foix, and the Departmental Councils of Haute Garonne and Ariège. Subscriptions (members, 30 francs; members receiving the report, 100 francs; associates, 20 francs) should be forwarded to the General Secretary and Treasurer, M. Ch. Schleicher, 9 rue de Verneuil, Paris (vii$^{e}$).

### Announcements

AMONG the appointments and promotions in the Colonial Service recently announced are the following: C. C. Webster to be agricultural officer, Nigeria; D. A. B. Davies to be field geologist, British Guiana; H. A. Smith to be divisional engineer, Posts and Telegraphs Department, Nigeria; A. A. Strachan to be senior engineer, Posts and Telegraphs Department, Malaya.

ON August 14, M. Georges Détré, a French airman, established a new world altitude record of 14,836 metres (48,674 ft.) at Villacoublay. According to the Paris correspondent of *The Times*, this figure exceeds by more than 400 metres (1,749 ft.) the previous record set up by the Italian, Signor Donati, in April 1934. The machine used by M. Détré was a Potez 50 Special fitted with a Gnôme-et-Rhône *K*.14 engine.

The Council of the Iron and Steel Institute makes annually a limited number of grants from the research fund founded by the late Mr. Andrew Carnegie in aid of metallurgical research work. The object of the scheme is to enable qualified students to conduct researches on problems of practical and scientific importance relating to the metallurgy of iron and steel and allied subjects. Candidates, who must be less than thirty-five years of age, must apply before September 30, on a special form to be obtained from the Secretary of the Institute. The maximum amount granted in any one year will, as a rule, not exceed £100.

OF 2,590 offenders examined in the psychiatric clinic of the Court of General Sessions, New York, within the past year, less than 1 per cent were found to be definitely insane.

DR. MAXIMILIAN EHRENSTEIN, research fellow in physiology, Department of Medicine, University of Virginia, has been awarded one of the prizes of the Van't Hoff Fund by the Royal Academy of Sciences of Amsterdam in recognition of his work on the alkaloids of tobacco and the catalytic dehydrogenation of cyclic bases.

WE have received from the City Librarian of Leeds eight bulletins or catalogues of technical engineering books. They are divided into the following eight groups: (1) mechanics and materials; (2) mechanical engineering; (3) workshop practice; (4) civil engineering; (5) mining engineering; (6) metallurgy and metal working; (7) electrical engineering—part I; (8) electrical engineering—part II. Each of the catalogues is subdivided, so it is a very simple matter to find out the standard technological works dealing with a particular subject. The address is Leeds Public Libraries, Municipal Buildings.

IN the letter "Anomalies in the Fine Structure of the First Spark Spectrum of Iodine" (NATURE, June 20, p. 1030), the line $\lambda$ 4060·2 is said to consist of three components: 0·000 (4), + 0·081 (3), + 0·121 (2) cm.$^{-1}$. Dr. K. Murakawa informs us a mistake occurred in his manuscript; this line should read: 0·000 (2), + 0·081 (3), + 0·121 (4) cm.$^{-1}$.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Temporary assistant civil engineers in the Air Ministry—The Secretary (W.B.9), Room 712, Adastral House, Kingsway, W.C.2 (August 22).

A part-time teacher of zoology and/or biology in the Northern Polytechnic, Holloway, N.7—The Clerk (September 4).

An experimental assistant in a War Department establishment at Woolwich—The Superintendent, Signals Experimental Establishment, Woolwich Common, S.E.18 (September 4).

Junior scientific officers in the National Physical Laboratory, Teddington—The Director (September 15).

An instructor in electrical engineering in the Bulawayo Technical School—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Rhodesia House, 429 Strand, W.C.2 (September 19).

A professor of anatomy in the University of Manitoba—The Dean, Faculty of Medicine.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 332.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Variation of Cosmic Ray Intensity with Sidereal Time

HOURLY records of the intensity of the cosmic radiation have been made at Cape Town since February 1933 in accordance with a scheme organized by Steinke, Hess and others for the study of the radiation. The instrument consists of an ionization chamber and electrometer provided with photographic registration. The rise of collector potential is compensated every half-minute by a condenser potentiometer device, and the accuracy of a single hourly observation is 0·1 per cent.

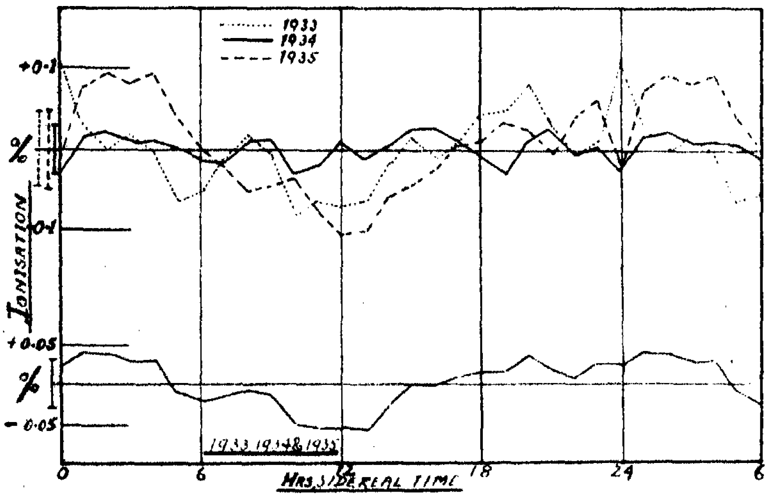


FIG. 1.

We wish to report upon the sidereal time variation during three years of observation, in which for two thirds of each month the chamber was totally enclosed in a shield of lead 10 cm. thick. Each observation has been reduced to a standard pressure of the absorbing atmosphere. Hourly means of intensity have been plotted in the upper set of curves (Fig. 1) for the years 1933, 1934 and 1935, and the combined observations for the three years are shown in the lower curve. The total number of hours of observation is 14,094. Probable errors (root mean square deviations) are indicated by vertical lines on the left-hand side.

It will be seen that the lower curve shows a variation of some 0·04 per cent of the mean, roughly sinusoidal, with maximum at about 24 hr. local sidereal time and minimum at 12 hr. A similar variation is found in the separate curves for 1933 and 1935, but is not definitely indicated in 1934. A variation of this character and phase has been noticed in the observations of Hess and Steinmaurer[1] on the Hafelekar in 1932. Compton and Getting[2] have ascribed it to the effect of the galactic rotation, which if the rays came uniformly from outer space would cause a maximum to be observed in both hemispheres at 21 hr. local sidereal time. They have pointed out the importance of observations in the southern hemisphere, for if the effect observed in the northern hemisphere were due to a seasonal change in the well-known solar diurnal variation, that in the southern hemisphere should show a maximum at 9 hr., being shifted in phase by 12 hr.

Since no such phase shift is observed, we conclude that the very small variation found in both hemispheres is a true sidereal time effect.

B. F. J. SCHONLAND.
B. DELATIZKY.
J. P. GASKELL.
University,
Cape Town.

[1] V. F. Hess und R. Steinmaurer, *Sitzb. Pr. Akad. der W.* (Phys. Math. Klasse), **15**, 15 (1933).
[2] A. H. Compton and V. Getting, *Phys. Rev.*, **47**, 817 (1935).

## Measurements of Cosmic Ray Intensity in a Deep Mine

IN a coal mine in the neighbourhood of Budapest, at a depth of 315 m. below the surface, we made measurements of the cosmic ray intensity with triple coincidence apparatus. To obtain still thicker layers of material we measured the intensity at different angles from the vertical, using a very narrow aperture. The results of these experiments show that cosmic rays penetrate through a layer with a thickness of 2,500 m. water-equivalent. For corpuscular rays this will mean that the energy of the particles must surpass $10^{13}$ e.volt, using the formula of Bethe. The intensity distribution was found to be as follows: 1,700 coincidences per hour on the surface, 0·78 coincidences per hour at an effective depth of 700 m. of water and 0·09 coincidences per hour at 2,500 m. effective depth.

We found, further, that cosmic rays may produce showers even after passing through 700 m. water-equivalent, and that the penetrating power of the shower-particles is of the same magnitude as that usually stated for level measurements.

J. BARNÓTHY.
M. FORRÓ.
Institute for Experimental Physics,
University of Budapest,
Budapest. July 22.

## Ranges of Particles emitted by Samarium

IN view of some divergences in the determinations of the range of the $\alpha$-particles of samarium, Prof. Wertenstein suggested that I should make some new experiments on this subject.

The ionization chamber used for determinations of ranges consisted of a spherical glass bulb, of 6·9 cm. radius, with silvered inner walls, and a concentric steel sphere of 1 cm. radius, on which a thin layer of the substance under examination could be deposited. This sphere was connected to a Hoffmann electrometer, while the bulb was put into communication with a vacuum pump. The ionization due to samarium was measured at different pressures. The sensitivity of the electrometer varied within small limits, but was on the average 30,000 ions for a division.

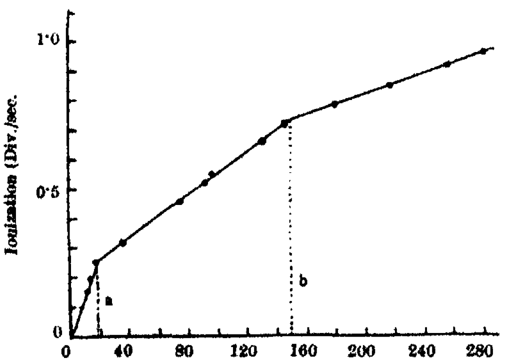


FIG. 1. Ranges of $\alpha$-particles from samarium. *a* is the new range observed; *b* is the known range of samarium particles.

The curve in Fig. 1 shows the ionization current as a function of the pressure for a film of samarium oxide ($Sm_2O_3$) of 0·416 mgm./cm.$^2$. (A specimen of pure samarium oxide was kindly lent by Prof. G. v. Hevesy to Prof. Wertenstein.) The position of the kink corresponding to the range of $\alpha$-particles of samarium can be determined with great precision. From this position I find that this range is equal at 760 mm. and 15° to 1·150 cm., in good agreement with the value recently found by R. Hosemann[1].

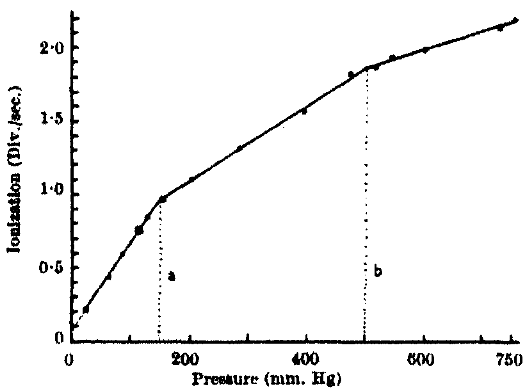


FIG. 2. Ranges of $\alpha$-particles from samarium and polonium. *a* is the range of particles from samarium; *b* is the known range for particles from polonium.

The curve in Fig. 2 was obtained with a film of 1·05 mgm./cm.$^2$ of samarium oxide to which a very small amount of polonium was added for calibration. The position of the kink due to $\alpha$-particles of samarium is exactly the same as in Fig. 1, while the range of $\alpha$-particles of polonium I find to be 3·907 cm., in excellent agreement with recent data.

The interesting fact is that the curve in Fig. 1 shows also another kink, clearly indicating the existence of ionizing particles of much shorter range, namely, 0·13 cm. The existence of these particles is also confirmed by the fact that the straight line continuation of the curve in Fig. 2 does not pass through the origin of co-ordinates but above it.

The total ionization due to these particles is equal to about 35 per cent of the total ionization due to $\alpha$-particles, which makes it highly improbable that the particles of short range should be recoil atoms of any element formed during the disintegration of samarium. No adequate explanation of the nature and origin of these particles has so far been found, and further experiments are in progress.

LEON LEWIN.

Laboratory of Atomic Physics,
Free University of Poland,
Warsaw.
July 16.

[1] R. Hosemann, *Z. Phys.*, **99**, 405 (1936).

## Absorption of Thermal Neutrons in Silver at Low Temperatures

WE have measured the absorption curves for neutrons of Fermi's[1] group 'C' using a silver target (2·3 min. activity) as detector, in the centre of a large Dewar vessel containing either liquid hydrogen or water at room temperature. Source, absorber and target were kept at room temperature. The intensity of the *C* group was determined in the usual way by taking the difference between the whole activity and that obtained by screening the target with 0·3 mm. cadmium. If a Maxwellian distribution for the energies of neutrons of this group be assumed, and if the $1/v$ absorption law predicted by theory is valid for silver, the ratio of the absorber thickness necessary for equal absorption at different temperatures would be expected to be independent of the absorption itself and to be equal to the square root of the inverse ratio of the temperatures. Experimentally we found that this ratio for 290° K. and 20·4° K. is in fact constant over the whole of the absorption curves; its value, however, was found to be 2·2 ± 0·2, instead of 3·8 to be expected from the $\sqrt{T_2}/\sqrt{T_1}$ hypothesis. One of the silver absorbers was measured also at 77° K. in paraffin and the ratio of thickness was also in this case considerably smaller than that given by the theory, the point being nearer to 290° K. than to the 20·4° K. curve. The results of the measurements are given in the table below.

| Temperature (Kelvin) | Thickness of absorber mm. | gm./cm.$^2$ | Transmission for *C*-neutrons per cent |
|---|---|---|---|
| 20·4° | 0·26 | 0·0273 | 58·5 ± 3·8 |
| | 0·50 | 0·0525 | 48·1 ± 2·5 |
| | 0·64 | 0·0672 | 40·0 ± 2·0 |
| | 2·0 | 0·210 | 15·3 ± 2·2 |
| | 3·0 | 0·315 | 9·4 ± 3·6 |
| 77° | 0·64 | 0·0672 | 57·5 ± 2·8 |
| 290° | 0·64 | 0·0672 | 63·8 ± 2·0 |
| | 2·0 | 0·210 | 31·4 ± 4·4 |
| | 3·0 | 0·315 | 22·2 ± 1·2 |

We must conclude, therefore, that at low temperatures either the energy distribution of neutrons in the $C$ group is not given by Maxwell's law or the $1/v$ law does not hold for the absorption of $C$ neutrons in silver, using the second period as detector.

V. FOMIN.
F. G. HOUTERMANS.
I. W. KURTSHATOV.
A. I. LEIPUNSKI.
L. SHUBNIKOV.
G. SHTSHEPKIN.

Ukrainian Physico-Technical Institute,
Kharkov.
June 18.

[1] E. Amaldi and E. Fermi, *Ricerc. Scient.*, ser. II, 7, vol. 1, No. 11-12. See also F. Rasetti and G. A. Fink, *Phys. Rev.*, **49**, 642 (1936) and P. N. Powers, G. A. Fink and G. A. Pegram, *Phys. Rev.*, **49**, 650 (1936).

## Cross Linkage Formation in Keratins

OWING to the breakdown of salt and sulphur linkages, and consequent rearrangement of the peptide chains, untreated wool fibres contract 30 per cent in length in boiling sodium bisulphite solution, whereas fibres containing stable linkages between the peptide chains fail to contract under similar conditions[1]. This fact has been used to show that baryta-treated fibres contain —S—Ba—S— bonds[2], and set fibres contain —S—NH— bonds[3] between the peptide chains. In addition, since caustic soda-treated fibres fail to contract in sodium bisulphite solution, it was suggested that —C—S—C— bonds are formed by the action of caustic soda on the cystine linkage, thus explaining why skins are more difficult to unhair after treatment with alkali[4]. In support of this view, it was pointed out that Harris had failed to reduce the sulphur content of wool fibres to less than half its original value by caustic soda treatment[5], and that Küster and Irion had isolated a —C—S—C— derivative from the products of the action of sodium sulphide on wool[6]. More recently, Harris[7], taking advantage of the work of Zincke and Farr[8], and of Schöberl[9], has shown that aldehyde groups are produced by loss of hydrogen sulphide from the sulphenic acid derived from the disulphide bond by alkaline hydrolysis, and Phillips[10] has suggested that the aldehydes may condense with the basic side chains of wool to produce —N=CH— bonds between the peptide chains.

This suggestion appears to be valid, because caustic soda-treated fibres, which fail to contract in boiling sodium bisulphite solution, contract after being subjected to treatments calculated to break —N=CH— bonds. For example, caustic soda-treated fibres, boiled in $N/5$ hydrochloric acid for 30 minutes, contracted 16 per cent in boiling 5 per cent sodium bisulphite solution; and treated fibres boiled in $N/10$ pyruvic acid for 1 hour contracted 14 per cent under similar conditions[11]. It seems probable, therefore, that —N=CH— bonds are present in caustic soda-treated fibres, although the incompleteness of the contraction implies that other types of bond are present, possibly the —C—S—C— bond first mentioned in this connexion.

Although Phillips makes no such suggestion in his note[10], it might be assumed that the new linkages formed in 'setting' stretched fibres in steam are —N=CH— in type, rather than the —S—NH— bonds first postulated. This does not seem to be the case, because fibres set in boiling 2 per cent borax solution fail to contract in boiling $N/5$ hydrochloric acid or $N/10$ pyruvic acid. Not only so, but the fibres boiled in $N/5$ hydrochloric acid retain a set even in boiling sodium bisulphite solution. Similarly, if permanent set were due to the formation of —N=CH— bonds, the response of fibres to setting processes should be increased by pretreatment with alkalis to develop aldehyde groups. In actual fact, setting power decreases steadily with increasing time of treatment with alkali, the amount of permanent set being a linear function of sulphur content in the case of baryta-treated fibres. These and other observations, which will be described elsewhere, find a ready explanation in terms of —S—NH— bond formation in setting processes, but no explanation in terms of the —N=CH— bond.

J. B. SPEAKMAN.

Textile Chemistry Laboratory,
University, Leeds.
July 25.

[1] Speakman, NATURE, **132**, 930 (1933).
[2] Speakman, Applied Chemistry Reports, **20**, 164 (1935).
[3] Speakman, *J. Soc. Dyers and Colourists*, Jubilee Number, 1934, p. 34.
[4] Whewell, Ph.D. Thesis, University of Leeds, 1935.
[5] Harris, *Bur. Stand. J. Research*, **15**, 63 (1935).
[6] Küster und Irion, *Z. physiol. Chem.*, **184**, 225 (1929).
[7] Harris, *Bur. Stand. J. Research*, **16**, 475 (1936).
[8] Zincke und Farr, *Annalen*, **391**, 57 (1912).
[9] Schöberl, *Annalen*, **507**, 111 (1933).
[10] Phillips, NATURE, **138**, 121 (1936).
[11] Fischer, *Annalen*, **253**, 63 (1889).

## Effect of Dichlor-diethyl-sulphone on Brain Respiration

MY colleagues and I have been developing recently the theory that vitamin $B_1$ is a specific factor in the oxidation system of pyruvic acid. In a search for substances which would inhibit specifically this action of vitamin $B_1$ in its relation to the pyruvate oxidase of brain, I tried ten months ago the effect of dichlor-diethyl-sulphone $(Cl.CH_2.CH_2)_2\ S.O_2$, for a specimen of which I am indebted to Dr. E. Walker. I am encouraged to communicate the results by the recent publication of Berenblum, Kendall and Orr[1], who state that D.E.S. with tumour tissue inhibits respiration some 50 per cent and glycolysis some 84 per cent. I have found that the action of D.E.S. upon our brain respiration systems *in vitro* resembles in detail the effect of iodoacetic acid[2]; the significant points are as follow:

Noticeable effects upon respiration in lactate Ringer phosphate solutions are produced by so little as $0\cdot000087\ M.$ (up to 50 per cent inhibition) D.E.S. With $0\cdot000174\ M.$ (similar concentration for iodoacetic acid, $0\cdot005\ M.$ approx.) and our usual technique, pyruvate is not oxidized, but accumulates from normal respiring brain tissue in presence of lactate. Hence at this concentration in the reactions

$$\text{Lactate} \xrightarrow[C]{} \text{Pyruvate} \xrightarrow[D]{\text{D.E.S.}\ \downarrow\ \text{iodoacetic acid}} \text{oxidation products}$$

there is no appreciable effect upon step $C$, but only upon $D$. Lack of vitamin $B_1$ also affects stage $D$, but as with iodoacetic acid, the action is not upon the vitamin $B_1$ component. Addition of excess vitamin $B_1$ will not restore the action with normal brain

tissues, nor is the toxic effect removed by addition of glutathione (GSH), provided that time has elapsed to permit complete action of the D.E.S., which is rather slow (it needs some 30 min. at 38° C., *p*H 7·3). Further proof that the vitamin $B_1$ component is not involved lies in the following: Vitamin $B_1$ incubated for 35 min. at 38° C. with D.E.S. in excess (*p*H 7·3) can be proved to be still active by detoxicating the excess D.E.S. present with GSH and testing the solution so formed.

The similarity in action of iodoacetic acid and D.E.S. upon the pyruvate oxidase system is of interest in relation to the similar vesicant action of these compounds, and possibly of interest in tumour research.

RUDOLPH A. PETERS.
Department of Biochemistry,
Oxford.
July 29.

[1] Berenblum, Kendall and Orr, *Biochem J.*, **30**, 709 (1936).
[2] Peters, Rydin and Thompson, *ibid.*, **29**, 53 (1935).

## A Hardness Tester for Microscopical Objects

INCLUSIONS and structural elements of metallographic specimens can be identified by examining the effect of various etching reagents. This method not only takes up a great deal of time, but also demands considerable experience on the part of the examiner.

FIG. 1.

A more convenient and objective identification can be obtained by measuring the hardness of the inclusions and structure elements themselves. Instead of using the scratch hardness tester, which offers considerable difficulties[1], we have designed for this purpose a small and simple instrument, the basic

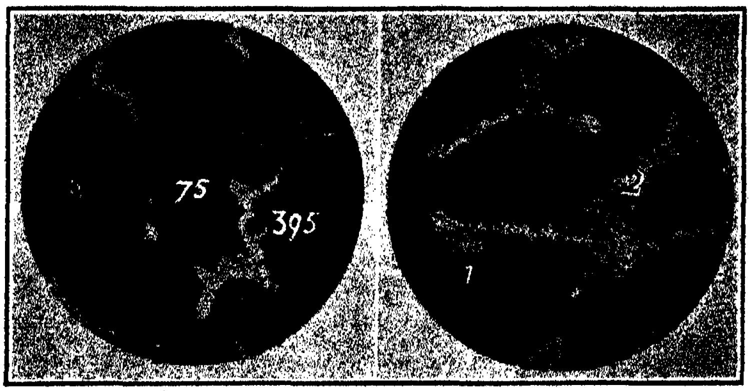


FIG. 2. Micrographs of (*a*) cast aluminium alloy containing 7·5 per cent copper (× 150); (*b*) pearlitic cast iron containing 0·8 per cent phosphorus (× 300).

principle of which corresponds exactly with that of the hardness testers of Vickers and of Firth. Fig. 1 shows the instrument mounted in the revolving head of a microscope with a vertical illuminator. The hardness tester consists of a Vickers' diamond *A* with a pyramid-shaped point, which is fixed in a piston *B*. The piston, having a certain weight, can move freely in a cylinder *C*.

The hardness, for example, of an inclusion or of a structural element, is tested in the following manner. The element to be tested is brought into the centre of the field of vision. Then, by turning the revolving head, the hardness tester is brought into the optical axis of the microscope. The tube of the microscope is moved downwards to such an extent that the diamond rests on the specimen and makes a small square impression in the structural element. After a certain time (for example, 30 sec.) the tube of the microscope is again moved upwards and the revolving head turned through 180°. By means of an ocular micrometer, the length of the diagonal of the square is measured, which can be expressed in Vickers numerals in the usual manner.

Fig. 2 (*a*) is a micrograph of a cast aluminium alloy containing 7·5 per cent of copper. The impressions caused by the diamond are clearly visible. The corresponding hardness numerals have been inserted in the figure.

Fig. 2 (*b*) is a micrograph of pearlitic cast iron, containing 0·8 per cent of phosphorus. The diamond impressions in the pearlite and the phosphide eutectic are marked 1 and 2 respectively. The corresponding hardnesses are 395 and 775 respectively. The Vickers hardness *V*/20 was 243.

In the case of malleable cast iron, the hardness of the ferrite was 182, that of the pearlite 300. For martensite a hardness of 865 was measured, whilst cementite showed a hardness of 820.

In the examples mentioned above, the load of the diamond is equal to the weight of the piston, namely, 35 grams. It is, however, possible to use arbitrary loads by means of air pressure above the piston. For this purpose an air inlet *D* is fitted to the cylinder *C* (Fig. 1). In this way the instrument

can be applied to normal metallographic microscopes. A further advantage of the apparatus described is that it can be used during ordinary examination of metallographic specimens.

E. M. H. LIPS.
J. SACK.

Natuurkundig Laboratorium
der N. V. Philips' Gloeilampenfabrieken,
Eindhoven.
June 2.

[1] Bierbaum, "The Microcharacter", *Trans. American Society for Steel Treating*, 18, 1009 (1930). Gillet, "Properties of Ferrite as Revealed by Scratch Hardness Tests", *Metals and Alloys*, 5, 159 (1934).

## Measurements of Noise

THOSE interested in noise measurement will be aware that a new unit of equivalent loudness, the British Standard Phon, has been introduced by the British Standards Institution (Glossary of Acoustical Terms and Definitions B.S. 661—1936). The standard of reference is a plane sound wave of 1,000 cycles per sec., heard alternately with the noise to be measured by an observer facing the source and listening with both ears. When the reference tone is judged by a 'normal observer' to be as loud as the noise, the equivalent loudness in phons is given by the intensity level of the reference tone above a reference pressure of 0·0002 dyne per sq. cm. The experimental realization of the definition requires the resources of a laboratory, so that it becomes of interest to inquire how far the indications of portable secondary meters used for measurements in the field conform to the standard.

Many subjective secondary meters developed before the formulation of the standard, including one developed by us, operate by the observer listening simultaneously to the noise with one ear and a pure reference tone, presented by a telephone receiver, with the other. The reference tone is then adjusted by trial to loudness equality with the noise, the magnitude of which is expressed as the intensity of the reference tone in decibels above a stated reference intensity. In view of the disparity in listening conditions, it is important to ascertain whether the meter indications conform to the standard. We have carried out measurements, in accordance with the definition, of the equivalent loudness of noises of many types with a group of ten observers, such noises being also measured by the same group using a subjective meter of the type indicated above. It is found that with an instrument adjusted to read correctly for 1,000 cycle high-intensity tones, there are discrepancies of varying amounts up to + 15 db., depending upon the type of noise. For some purposes a correction of − 6 db. to the reading brings the indications sufficiently near to the standard.

A mode of listening approximating more to the definition is made possible by using a meter with two receivers. If suitable sealing is provided, the noise and reference tone may be heard alternately by quickly removing or replacing the receivers on the ears. The reference tone intensity is adjusted by trial until no loudness change is heard on removing or replacing the receivers. Tests with a meter constructed on these lines and calibrated in a 1,000 cycle free field show that for a variety of types of noise from 30 to 95 phons, the true value is given on an average to ± 2·5 phons, the largest discrepancy in mean reading noted being 4 phons.

A meter of this type thus enables the measurement outside the laboratory of any type of steady noise in phons. It has been used for measuring the noise of large engineering plant and has been found more trustworthy than the single-telephone method. The two-telephone meter also forms a link between the plane field distribution of the phon definition and the irregular field distributions which may occur in practice. Such an irregular sound field is thereby assessed in terms of the intensity level of the 1,000 cycle plane wave which, for a 'normal observer', produces an equal loudness sensation. Thus the pronounced directional properties of some microphones, which may have an arbitrary effect in objective noise measurements, may be eliminated.

The performance of secondary meters in terms of the phon will be discussed in a paper which it is hoped to publish in the near future.

B. G. CHURCHER.
A. J. KING.

Research Department,
Metropolitan-Vickers Electrical Co., Ltd.,
Manchester, 17.
July 18.

## Influence of Temperature on Crossing-over in *Drosophila*

ALTHOUGH it has now been demonstrated by several workers that crossing-over in certain regions of the chromosomes of *Drosophila melanogaster* is affected by temperature, the experiment reported in Table 8 of Plough's classical paper[1] still remains the only attempt to trace the magnitude of the effect throughout the range of temperature over which *Drosophila* is fertile. Unfortunately, when correcting the data for differences among the controls, a mistake was made which led to the false conclusion that crossing-over showed two maxima, at 13° and at 31° C. The *b–pr–c* region of chromosome II was used for the

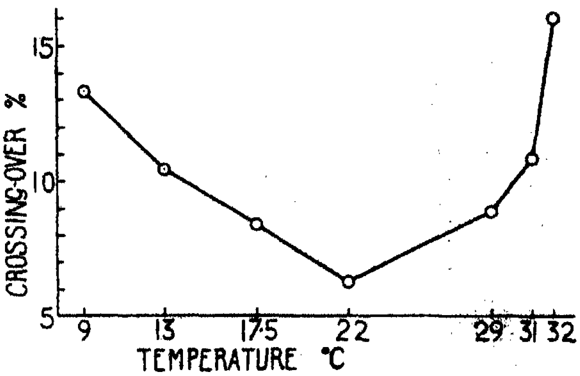


FIG. 1.

experiment. The observed percentages of crossing-over between *b* and *pr* are reproduced in the table below:

Table 1.—Crossing-over between *b* and *pr*. (Data from Plough's Table 8).

| Temperature °C. | Observed per cent | Control at 22° C. | Corrected values, that is, 6·0 (Observed)/Control |
|---|---|---|---|
| 9 | 13·5 | 6·1 | 13·3 |
| 13 | 13·5 | 7·8 | 10·4 |
| 17·5 | 8·3 | 5·9 | 8·4 |
| 22 | 6·0 | — | 6·0 |
| 29 | 8·8 | 5·9 | 8·9 |
| 31 | 14·0 | 7·8 | 10·8 |
| 32 | 15·7 | 5·9 | 16·0 |

When corrections for the controls are properly applied the relation between crossing-over and temperature is seen to conform to a simple *U* curve (Fig. 1).

This mistake came to my notice in 1927, but having no first-hand interest I was content to communicate the error to colleagues more specifically interested in genetics of *Drosophila*. It has recently, however, been brought to my notice that the mistake is still a source of trouble. Besides having been reproduced in a number of text-books, the supposed maximum at 13° is of some importance in correlating these data with observations on the effect of temperature both on contraction of muscles (Plough[1]) and on chiasma frequency in *Acridiidæ* (White[2]).

H. FAIRFIELD SMITH.

Galton Laboratory,
University College,
London, W.C.1.
July 22.

[1] H. H. Plough, "The Effect of Temperature on Crossing-over in *Drosophila*". *J. Expt. Zool.*, **24**, 147–209 (1917).

[2] M. J. D. White, "The Influence of Temperature on Chiasma Frequency". *J. Genetics*, **29**, 203–215 (1934).

## Tetraploidy and Hymenoptera

A COMMUNICATION[1] from B. R. Speicher has directed attention to certain genetical data which do not seem to favour my suggestion[2] that the 'pre-conjugation' phenomena observed in the gametogenesis of the honey bee and of *Cynips kollari* may be interpreted in terms of derived tetraploidy. Now while I admit that the findings of the experiments of Dzierzon, Michailoff and Newell, as quoted in Mr. Speicher's letter, do suggest a simple condition of female diploidy and male haploidy, the facts are by no means fatal to a theory of derived tetraploidy–diploidy based on cytological observations. It has recently been shown that tetraploid hybrids do not necessarily exhibit independent segregation of chromosomes in gametogenesis and also that gametic viability in these forms is often differential, and only those gametes carrying one complete genom or the other are functional. It is thus possible for an organism to behave *genetically* as a diploid while in its gametogenesis traces of a different cytological condition may be shown. Genetical methods, therefore, may not be infallible criteria of evolution.

In this connexion, it should be observed that, in my original communication, the phenomena under discussion were regarded as vestiges in the evolutionary sense. At the same time it may be noted that there is probably conflict in the use of the terms tetraploidy, diploidy and haploidy, as employed by geneticists and by cytologists.

FRANK GREENSHIELDS.

4 Airlie Terrace,
Dundee.
July 28.

[1] B. R. Speicher, NATURE, **138**, 78 (1936).

[2] F. Greenshields, NATURE, **137**, 662 (1936).

## Refractive Indexes of Ordinary and Heavy Ammonia

MEASUREMENTS of the refractive index of light and heavy ammonia were performed in continuation of former investigations[1]. The interferometer and the experimental arrangements were the same as before with the exception that this time one tube was made of glass and the other of quartz. A discharge tube containing hydrogen, a mercury lamp and a sodium lamp served as sources of light. The spectral lines in question were separated out by means of a monochromator from Winkel-Zeiss.

$NH_3$ (or $ND_3$) were produced by adding ordinary water drop by drop (or heavy water, 99 per cent, from Norsk Hydro-Elektrisk Kvælstofaktieselskab) to magnesium nitride. The drying and purification of the gas were performed in a manner similar to that described in the paper dealing with ordinary and heavy hydrogen selenide. The pressure of the gas was between 25 cm. and 28 cm. of mercury, the temperatures between 15° and 20° C. The reduction of the refractive index to the normal conditions and the state of an ideal gas was performed by using the coefficient of dilatation at constant pressure:

$$\alpha_{15,H} = 0 \cdot 00366 + 0 \cdot 000182 \frac{H}{76}.$$

For the quantity $\varphi$ which gives the deviation from Boyle's law the value 0·015 was used from the "International Critical Tables".

The results of the measurements are to be found in the accompanying table.

$(n_0 - 1) \times 10^6$.

| $\lambda \times 10^8$cm. | 6562·9 | 5893 | 5461 | 4916 | 4358 |
|---|---|---|---|---|---|
| $NH_3$ | 373·6 | 375·7 | 377·7 | 381·4 | 386·3 |
| $ND_3$ | 369·4 | 372·6 | 374·1 | 378·2 | 383·3 |
| $\Delta$ | 4·2 | 3·1 | 3·6 | 3·2 | 3·0 |

The refractive indexes of $NH_3$ are in good agreement with the measurements of C. Cuthbertson[2], while the measurements of S. Friberg[3] and E. W. Cheney[4] are perceptibly higher.

The method used by the measurements of $NH_3$ and $ND_3$ being completely consistent, the differences found between $n_{0,\,NH_3}$ and $n_{0,\,ND_3}$ are to be regarded as real in all circumstances.

O. E. FRIVOLD.
O. HASSEL.
S. RUSTAD.

Department of Physics and
Department of Physical Chemistry,
University, Oslo.
June 9.

[1] O. E. Frivold und O. Hassel, "Brechungsindex u. Molrefraktion des $SeH_2$ für die $D_1$-linie", *Z. phys. Chemie*, B, **27**, 316 (1934).
O. E. Frivold, O. Hassel und T. Skjulstad, "Brechungsexponent u Molrefraktion des Selenwasserstoffs u. des Selendeuterids", *Phys. Z.*, **37**, 134 (1936).

[2] Loria, "Lichtbrechung in Gasen".

[3] *Z. Phys.*, **41**, 378 (1927).

[4] *Phys. Rev.*, **29**, 292 (1927).

## Range of Action of Surface Forces

THE letter by Bowden and Bastow, published in NATURE[1] (as well as their communication to the Royal Society[2]), not only may give, but already has given, rise to the view that the rigidity of thin water films observed by myself has not been confirmed by the above authors[3].

A thorough discussion and comparison of Bowden and Bastow's data with mine renders it manifest, however, that there is no contradiction between our respective results. Indeed, it has been shown by my data that the rigidity of water is

exhibited when the thickness of the film is less than $1 \cdot 5 \times 10^{-5}$ cm., that is, at a distance less than $0 \cdot 75 \times 10^{-5}$ cm. from the glass surface. Rigidity equal to that of lead has been observed in my experiments for distances of $0 \cdot 5 \times 0 \cdot 7 \times 10^{-5} = 0 \cdot 35 \times 10^{-5}$ cm. from the walls.

In accord with the subsequent measurements of Bowden and Bastow, my measurements have, therefore, refuted the indications of the existence of rigid films of liquids of considerably greater thickness to be found in other papers, among them in those by the late Sir William Hardy. The only difference lies in the fact that my measurements have established a smaller and at the same time a more accurate upper limit of the range of surface action for the case of a glass-water interface.

It only follows from Bowden and Bastow's experiments that the range of surface action modifying the mechanical properties of a liquid film does not exceed $2 \times 10^{-5}$ cm. for a glass surface, the liquid films in their experiments being located between a glass surface and a metal one, that is, one of another kind, and, moreover, a hydrophobic one. More than this, *the data given in Table I of their Royal Society paper* show that the thickness of the mobile part of the liquid is on the average *less* by $2 \times 10^{-5}$ cm. than the optically determined thickness of the gap between the solid surfaces. Although no great weight can be attached to the latter positive result, it shows that there is no question of Bastow and Bowden's data refuting my experiments.

B. DERJAGUIN.

Laboratory of Thin Films,
Institute of Colloid- and Electro-Chemistry,
Moscow, U.S.S.R.

[1] NATURE, 135, 828 (May 18, 1935).
[2] *Proc. Roy. Soc.*, A, 151, 220 (1935).
[3] NATURE, 135, 834 (1935), "Points from Foregoing Letters".

## Effect of Molecular Nitrogen on Molybdenum at High Temperatures

TREATING molybdenum wires of $0 \cdot 2$ mm. in a stationary manner by passing electric current through them and testing the behaviour of the wires under tensile stress, we have found that specimens heated in nitrogen are of quite a different character from those treated in hydrogen, argon or *in vacuo*. The yield point (in general, at the yield point of the wire plastic deformation of the metal commences) and the elongation of the wire in particular are very markedly influenced by nitrogen. Fig. 1 shows the load-extension curves of wires treated in nitrogen, the arrows indicating the yield point of the wire.

The following are the chief points of interest obtained in the course of our experiments. Different pre-treatments of wires exert an appreciable influence on the rate of nitriding. Thus cold-worked wires react much more slowly with nitrogen than they do if they are annealed, whilst the reaction is the slowest of all if the wires are fully recrystallized. In the later case, the characteristic stage represented in Fig. 1, No. 4, cannot be reached at all.

If nitrided wires (Fig. 1, No. 4) are permanently deformed, say, by being bent on little pulleys, they regain fully the original normal properties (Fig. 1, No. 1) which they possessed prior to nitriding. It seems possible that the failure to detect hitherto the effect of nitrogen on molybdenum wires is due to this peculiar fact. But nitrided wires after being bent revert again to their 'nitrided' stage (Fig. 1, No. 4) *if they are flashed even in argon for 1–2 sec.*

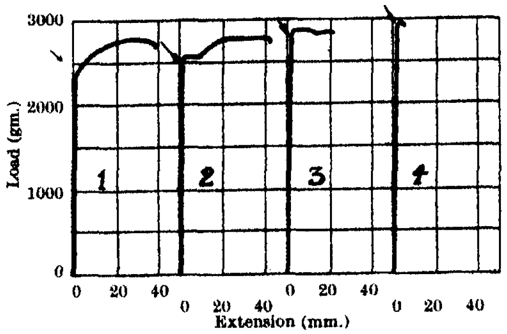


FIG. 1. (1) Wire treated at 1400° C. for 2 min. only in hydrogen. (2), (3) and (4). Wire pre-treated as (1) and then at 1300° C. for 20 sec., 40 sec. and 1 min. respectively in nitrogen.

On nitriding, no changes in the electrical resistivity was observed. The quantity of nitrogen sorbed corresponding to the stage of No. 4 in Fig. 1 is not more than about $0 \cdot 007$ per cent[1]. If nitrided wires are heated in hydrogen or *in vacuo*, denitriding takes place. Both contamination of the surface of the wire by carbon and minute traces of oxygen or/and water-vapour present in the gas retard the penetration of nitrogen into the wire.

Our observations appear to be of interest in relation both to the nature of plastic deformation of metals in general and to that of the catalytic action of molybdenum on ammonia synthesis[2].

We hope to publish fuller data elsewhere at a later date.

PAUL TÚRY.
STEPHEN KRAUSZ.

Research Laboratory,
United Incandescent Lamp and Electrical Co.,
Ujpest 4, near Budapest, Hungary.
June 22.

[1] C. J. Smithells and C. E. Ransley state that nitrogen diffuses through molybdenum (*Proc. Roy. Soc. London*, 152 (1935).
[2] W. Frankenburger, "Zum heutigen Stand der Theorie der Ammoniak-Katalyse". *Z. Elektrochem.*, No. 1, 2, 5 (1933).

## Flora of the Canadian Eastern Arctic

IN preparing a flora of the northernmost regions of eastern North America, nowadays generally referred to as the "Canadian Eastern Arctic", I am attempting to gather together, revise and record fully all of the more substantial plant collections that have been made within the area concerned from the times of the earliest navigators and pioneer explorers to the present day. This area for the present purpose is to be defined as excluding Greenland, Ellesmere (the flora of which is well known) and Boothia Felix, but otherwise as comprising all the mainland of eastern North America that lies east of long. 95° W. and north of lat. 60° N., and all the islands of the arctic archipelago (including the 1,000-miles long Baffin Land) that lie either wholly or in part within these bounds.

Since a number of collections have already come to light in unexpected places, I am taking the liberty of asking you, through the medium of your widely read correspondence columns, kindly to make known my great desire to hear of any further collections

from within this area that I have not already seen in North America or shall not be likely to see in visiting the main European herbaria. I am now returning to the field with the Canadian Eastern Arctic Patrol to gather further material; from this or my other collections I should be pleased to make a presentation of duplicate specimens of high arctic plants in return for the courtesy of any loans of older collections that prove of interest.

NICHOLAS POLUNIN.

Gray Herbarium, Harvard University,
Cambridge, Massachusetts, U.S.A.,
and
Department of Botany, Oxford.
July 10.

## The Mysterious Number 137

IN NATURE of July 11, Sir Flinders Petrie points out that Sir Arthur Eddington's cosmical number, 137, is nearly the well-known 'Byrne's' number, 137129, the mantissa of the logarithm of which shows the *same succession of digits*. It is sometimes said to be the number which is equal to its logarithm; but actually of the number 137·129 . . we should say that one thousandth of the number is the logarithm, to base 10, of one hundredth of the number. This coincidence between Eddington's and Byrne's numbers can have no physical significance, because the coincidence depends on 10 being used for the scale of notation and the base of the logarithms. The older wisdom of Mars may have adopted scales and bases of twelve; if so, the Martian Eddington would have discovered the number $e5$ ($11 \times 12 + 5 = 137$), while the Martian Byrne would have shown that log (to base twelve) $1{\cdot}38e66 = 0{\cdot}138e66$. Raising this number two duodecimal places, we have $138{\cdot}e66$, in the scale of twelve, which equals 188·961 in our notation.

Other such Byrne type numbers can be found in all scales of notation, and they are all different. For example, in the scale and base of three, the Byrne number is 2110220, and 211·022 (in scale of three) only equals 22·296 in our notation.

C. L. T. GRIFFITH.

32 Cambridge Street,
London, S.W.1.
July 31.

## Points from Foregoing Letters

GRAPHS showing the average hourly intensity of cosmic rays at Cape Town for the years 1933, 1934 and 1935 are submitted by Dr. B. F. J. Schonland, B. Delatizky and J. P. Gaskell. A slight sinusoidal variation is apparent, with a maximum at about 24 hr. local sidereal time and a minimum at 12 hr. The variation appears to be a true sidereal time effect, since it occurs simultaneously in both hemispheres.

Measurements of cosmic ray intensity in a deep coal mine, carried out by Drs. J. Barnóthy and M. Fórro, indicate that some of the rays penetrate through a thickness equivalent to 2,500 m. of water. These would correspond to particles having an energy greater than $10^{12}$ electron volts.

New measurements by L. Lewin of the range of particles emitted by samarium show, in addition to the alpha-particles of 1·15 cm. range, also the presence of ionizing particles of 0·13 cm. range, amounting to about one third the total ionization due to alpha-particles.

The absorption by silver of 'thermal' neutrons at low temperatures (20·4° and 77° K.) has been determined by a group of investigators from the Ukrainian Physico-Technical Institute. They find that the ratio of the absorber thickness necessary for equal absorption at different temperatures, though constant, has a value of only about two thirds that to be expected if the absorption were inversely proportional to the velocity and a Maxwellian distribution for the energies of the neutrons be assumed.

The nature of the chemical linkages responsible for the contraction of wool when treated by various reagents is discussed by Dr. J. B. Speakman. He considers that the 'permanent set' is to be explained by the formation of —S—NH— bonds rather than in terms of —N=CH— bonds.

Prof. R. A. Peters describes the effect of dichlordiethyl-sulphone upon the respiration of brain tissue *in vitro*. As in the case of iodoacetic acid, there is no interference with the change of lactic to pyruvic acid, but the further oxidation of pyruvic acid is inhibited.

An instrument for testing the hardness of microscopic objects is described by Dr. E. M. H. Lips and J. Sack, who submit photomicrographs of copper-aluminium alloy and of cast iron containing phosphorus to illustrate the usefulness of the new apparatus.

Results of noise measurements made with earlier types of meters are compared by B. G. Churcher and A. J. King with values obtained by means of the new standard apparatus. The authors indicate conditions under which approximately equivalent results can be obtained.

H. F. Smith recalculates the percentage 'crossing-over' effect in the chromosomes of the fruit-fly at different temperatures, from the experimental results of Plough, allowing for differences among the controls. He points out that the graph has a U-shaped form with a minimum at 22° C., and that there are no maxima at 13° and 31° as sometimes stated.

The refractive indexes of ordinary and of heavy ammonia gas ($ND_3$) for various wave-lengths between 4358 and $6562{\cdot}9 \times 10^{-8}$ cm. have been determined by O. E. Frivold, Prof. O. Hassel and S. Rustad. The values for the heavy ammonia are slightly lower than those for ordinary ammonia.

Dr. B. Derjaguin directs attention to the fact that there is no disagreement between his findings that films of water of less than $1{\cdot}5 \times 10^{-5}$ cm. thickness have great rigidity, and the results of Bowden and Bastow, who have found no change from normal behaviour at thicknesses greater than $2 \times 10^{-5}$ cm.

Diagrams showing the hardening of molybdenum wires heated in nitrogen at 1300° C. (by passing an electric current) are submitted by P. Túry and S. Krausz. The quantity of nitrogen 'sorbed' by the molybdenum is small (about 0·007 per cent).

# Research Items

### Tuberculosis and Inheritance

As part of the laboratory work in connexion with a course in human biology in Johns Hopkins University, Baltimore, Prof. Raymond Pearl initiated a study of family history records with reference to families in which tuberculosis had occurred. Analysis and discussion of the data have elicited some interesting results (*Z. Rassenkunde*, 3, 3). The records examined include 3,608 individuals in the classification of parents and children. Taking all the offspring together, 11·3 per cent were tuberculous, which is in reasonable agreement with the known prevalence of tuberculosis in Baltimore at the time the records were taken. The families average between 4 and 4·6 children. Four types of mating were differentiated and the percentage of tuberculous offspring in each type noted. There were: Both parents tuberculous, 35·7 per cent; father tuberculous, 14·0 per cent; mother tuberculous, 13·0 per cent; neither parent tuberculous, 8·3 per cent. The smoothness and regularity of the results are noteworthy. The incidence in the non-tuberculous parentage is a little more than half that of the tuberculous – non-tuberculous mating. The rates of the two latter types are essentially in agreement, as might be expected theoretically, if it is assumed that tuberculosis is neither a sex-linked nor a sex-limited phenomenon. Further, the full tuberculous mating gives an offspring incidence a little more than four times that from the full non-tuberculous mating. The regular increase in the offspring percentage incidence, as the amount of parental tuberculosis increases, seems impossible of rational explanation on any other basis than that of hereditary influence, as the risk of contact infection is not quantitatively doubled. The risk of infection as between the children of tuberculous and non-tuberculous parentage would seem greater than is indicated by the figures. It seems impossible, with the data at present available, to postulate any simple rational Mendelian formula that will accurately describe the results.

### Archæology in Western Colombia

In 1935 Dr. Henry Wassén had the opportunity of examining a number of graves belonging to an ancient Indian settlement on the estate of El Dorado in the western Colombian Cordilleras, midway between Yotoco and Restrepo in the Department of Valle del Cauca (*Ethnologiska Studien*, 1936, No. 2: Göteborg Museum). Among the objects found in the neighbourhood described, but not found by the author, are two vessels painted in red-brown, of a characteristic shape, the neck rising from a horizontal plane. Three strong handles, adapted for carrying the vessel on the back, are at different levels. This arrangement does not appear to have been recorded previously among archæological finds in South America, but can be paralleled from Mexico. Further examples were obtained from the graves. Nine graves in all were opened up on four different sites. The type form is a shaft, oblong in section, the long sides orientated north and south, with a recess, or chamber, usually on the north, but here on the south side, elliptical or rectangular in shape. The shaft is here four to six metres deep, between one and two metres long, and approximating to a metre in breadth Examples have been recorded in which the shaft is 14–17 metres deep (Cauca) and even so much as 25 metres (Quinidio). The elliptical recess, with its long axis east and west, approximates to a metre in height, two to two and a half metres long and from 0·75 to 1·35 m. in breadth. One recess was a rectangular chamber of considerable size. In one group the recess was scarcely perceptible and not deep-seated. One grave had no recess. Another grave of a distinct type had a square shaft, 6·10 m. deep, with the chamber below the level of the bottom of the shaft, the entrance to the recess being closed by a grinding stone. This had evidently contained the body of a woman, as was shown by spindle whorls. A hair ornament in the form of nippers and a part of a nose ornament, as well as the position of the teeth, indicated that the head had been placed to the north. On analysis the nose ornament proved to be composed of gold (64 per cent), silver (9 per cent) and copper (27 per cent). Green stain on the teeth indicated the presence of copper. The skeletons had completely perished, except for a few fragments and some teeth.

### The Medusæ *Eirene* and *Helgicirrha*

Dr. P. L. Kramp clears up much confusion in his paper "On the Leptomedusæ of the Genera *Eirene* Eschscholtz and *Helgicirrha* Hartlaub" (*Vidensk. Medd. fra Dansk naturh. Foren.*, 99; 1936). True cirrhi are absent in *Eirene* but present in *Helgicirrha*, and on this character the genera may be divided. Twelve species of *Eirene* are distinguished here, and five or six species of *Helgicirrha*, the genotypes being *Eirene viridula* and *Helgicirrha schulzei*. A re-examination of material previously identified by the author as *Eirene viridula* shows that specimens from the coast of Belgium and the Straits of Dover (1930) are correctly identified, but the majority of those from the coast of Jutland (1927) belong to *Helgicirrha schulzei*, a few being *Eirene viridula*; those from the Straits of Gibraltar and the coast of Tunis (1924) are *Helgicirrha schulzei*, and those from the coast of Portugal (1910) are *Helgicirrha cari*.

### Sponges of the North Sea and Baltic

Dr. W. Arndt in his monograph Porifera (Systematische Teil) in "Die Tierwelt der Nord- und Ostsee", Lief. 27, Teil 3a$_1$ (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935) makes a very complete systematic survey of the sponges in these regions. There is a large sponge fauna to be found in the North Sea and Baltic, including representatives of many families. These are all described in detail, with good text figures, whilst useful keys of families, genera and species are given, with instructions for technique for studying living and preserved material, and an excellent bibliography. This most useful work on the fauna of the North Sea and Baltic keeps well up to standard in the present part, which also includes an interesting account of Thalassobionte und thalassophile Diptera Nematocera (Teil 11, $e_2$) by W. Hennig.

### Experimental Neoplasms

THE developing blastoderms of birds and reptiles occasionally exhibit, in the region of the primitive streak, proliferating masses of cells which, while they multiply freely, show no tendency to transform into embryos or embryonic structures. These pathological masses grow with considerable rapidity and exhibit all the characters of neoplasms, and for that reason they have been termed by Tur "neoplasmoides embryonnaires". This author has produced the same type of growth experimentally by means of a thermo-electric cautery (*Bull. Int. Acad. Polonaise*, July 1935). The platinum needle, which becomes white hot, is carried by a mechanism which enables it to be applied accurately to any given point on or near the blastoderm, and also to apply the heat for a definite period. It also allows the heat to be controlled without the loss that would take place in manipulating a heated needle through the albumen layer. After treatment, the aperture in the egg shell is sealed with a cover slip and incubation allowed to proceed. Freshly laid eggs are employed, and the heat applied to the centre of the area pellucida. In this manner, a neoplasm can practically always be produced, and like those occurring naturally they not only exhibit remarkable power of proliferation but also blood elements appear precociously. The author suggests that this phenomenon should be considered in relation to cancer.

### Haploids in Cotton

SEA ISLAND cotton produces haploids—known as 'man cotton'—in the proportion of one in three or four thousand plants. This type was described by Dr. S. C. Harland in 1920, but its haploid nature was not recognized until much later. By removing the testas of several thousand seeds of one variety, Harland found (*J. Hered.*, **27**, No. 6) that twenty seeds contained two embryos, which yielded in nearly every case one haploid and one diploid seedling. Indian workers have shown that in rice, where a high proportion of haploids also occurs, the same form of polyembryony exists. Such ovules may contain two embryo sacs, or it is possible that the diploid embryo arises from nucellar budding while the haploid develops from a parthenogenetic egg. Many of the cotton haploids are fertile with the pollen of other forms, although some are completely sterile. Harland suggests that if diploids could be produced from the haploids by the decapitation method, the resulting homozygous strains would be of much value in breeding work, especially in cotton, which is a highly heterozygous crop plant.

### Control of Downy Mildew of Tobacco

AN interesting method of controlling the fungus disease known as downy mildew, or blue mould, of the tobacco plant, is reported in an account by Science Service from Canberra, Australia. This describes the work of Dr. H. R. Angell, Messrs. J. M. Allan and A. V. Hill, who have shown that early infection can be prevented by raising seedlings in an atmosphere containing vapour of benzol or toluol. Special seed-beds covered with glass have been prepared, and numerous shallow vessels containing the benzol or toluol are placed within. The young seedlings make healthy growth, and when transplanted do not contract the disease. Large-scale field tests are in progress, and their results will be awaited with interest.

### The Heat Capacity of Ice

IT has been known for some years that the entropy of ice as given by the integral $\int_0^T C_p d\ln T$ does not agree with the value calculated from the entropy of water vapour as found from its band spectrum, there being a discrepancy of about 1 gm.cal. per degree per mol. W. F. Giauque and J. W. Stout (*J. Amer. Chem. Soc.*, **58**, 1144; 1936) have now redetermined the heat capacity of ice from 16·4 to 267·7° abs. The latent heats of fusion and evaporation are accurately known, and the value of the integral is thus found to be $44 \cdot 28 \pm 0 \cdot 05$ gm.cal./1°/mol. at 1 atm. and 298·1° Abs. The spectroscopic value is 45·10, leading to a discrepancy of 0·82. This is in agreement with a discrepancy of 0·806 calculated by Pauling on the assumption of random orientations of hydrogen bonds in ice, and the supposition that when ice is cooled to low temperatures it fails to attain the ordered arrangement which would correspond with zero entropy. It has been found that ice has no measurable heat capacity between 0·2 and 4° Abs., and the authors state that no difference in thermal properties of ice could be detected in samples prepared by slow or rapid cooling.

### Manganese Trichloride

ALTHOUGH the existence of a higher chloride of manganese, probably $MnCl_3$, has often been reported, its existence in the pure state has only recently been demonstrated. A. Chrétien and G. Varga (*Bull. Soc. Chim.*, **3**, 1263; 1936) have obtained the trichloride as a brown crystalline mass by acting upon manganic acetate, $Mn(C_2H_3O_2)_3$, with liquid hydrogen chloride at $-100°$. A violent reaction occurs, and an olive-green liquid is produced. This is evaporated to dryness at the same temperature. The solid may be heated to room temperature in a closed vessel with little decomposition. On heating, it evolves chlorine and leaves a white residue of manganous chloride.

### Spectra of *B*-Type Stars

Two papers by E. G. Williams on *B*-type stars have appeared recently in the *Astrophysical Journal* (**83**, 279 and 305). The first paper describes the spectrophotometric observations of 84 stars over the range 4922–3820 A. Intensities (expressed in equivalent widths) were obtained for all measurable lines in this range, and in addition line depths were measured for H and He lines. In the case of H and He lines it was also possible to obtain reliable contours, which were observed to be exponential in form except in diffuse-line stars, where the centres were rather blunt. The results of the first paper have been used in the second in an attack on the problem of classification, which presents well-known difficulties in the case of *B*-type stars. These difficulties, together with earlier attempts to overcome them, are first reviewed by the author, who decides that line ratios, rather than simple intensities, are preferable as criteria of classification. He suggests seven ratios, some of which involve the combination of line intensities from several different elements. The resulting classification is arranged to agree in the mean with the Henry Draper system, but with added subdivisions and with the numbers of stars in each subdivision progressing smoothly with type. Statistical relations between spectral type (as redetermined) and line intensities of various atoms are discussed, and some interesting luminosity effects are also obtained.

# New Heating Laboratory at the Building Research Station

By A. F. Dufton

"*In the field of heating and ventilation many phases are still beyond the realm of scientific analysis: as far as possible these topics should be studied for the benefits that might accrue. Scientific methods alone can give us the assurance that we are headed in the right direction, particularly in those departures from standard practice occasionally necessary in everyday application.*"—
RIETSCHEL, 1893.

PRACTITIONERS in the art of heating are dependent to a great extent upon rules-of-thumb, and are finding, in this age of progress, some difficulty in adapting standard practices and calculations to meet modern requirements. The introduction of panel-heating, for example, has not only made necessary a revision of ideas as to what constitutes a comfortably warmed environment but has brought out also the important fact that the received methods of computing the heat losses of a building are only directly applicable when the building is heated in the 'traditional' manner. The introduction of electric-heating, moreover, particularly of schools, has lent an added interest to the effect of the fabric of a room upon the rate of warming and to the general question of the economics of intermittent heating. The Institution of Heating and Ventilating Engineers, fully appreciating the importance of scientific research, expressed the desire to associate itself as closely as possible with any researches on heating and ventilation under the auspices of the Department of Scientific and Industrial Research, and offered to provide funds to enable this work to be accelerated and extended. With this encouragement, it has now been possible to implement a proposal that a room should be erected with walls, ceiling and floor exposed to controlled conditions, in order to facilitate the study not only of different methods of heating, of the problems of intermittent heating and of the influence of ventilation upon heating, but also of those phases of building construction of interest to heating engineers.

It has been considered a matter of first importance that the controlled conditions should be clearly defined and reproducible, and that they should be independent not only of outside weather conditions but also of the condition of the interior of the room. The idea of a test-room within a controlled enclosure is not new, and a certain number of such rooms have been described and built elsewhere. In each case, however, the controlled conditions have been secured by regulating the air-temperature throughout the enveloping space. This is extremely difficult to accomplish satisfactorily and it does not provide, moreover, a clearly defined enclosure, since it permits of variations in the temperatures of the enclosing walls, to which, of course, the walls of the test-room radiate.

In the heating laboratory which has now been erected at the Building Research Station, Garston (Fig. 1), the temperature of the air in the enclosure is not regulated, and the enclosure is controlled by means of an extensive system of panel-warming and panel-cooling pipes in the walls, floor and ceiling. This enclosure is defined when the temperatures of the various surfaces are specified.

As will be seen from Fig. 2, the heating laboratory comprises the test-room, surrounded by its enclosure, together with an engine-room and an instrument room. The test-room, which measures 18 ft. by 12 ft., is built of 9-in. brickwork, plastered internally, and the floor and ceiling are constructed of wooden joists, lathed and plastered below, and boarded above. The height of the ceiling can be adjusted between the limits of 8 ft. 6 in. and 11 ft. 6 in.

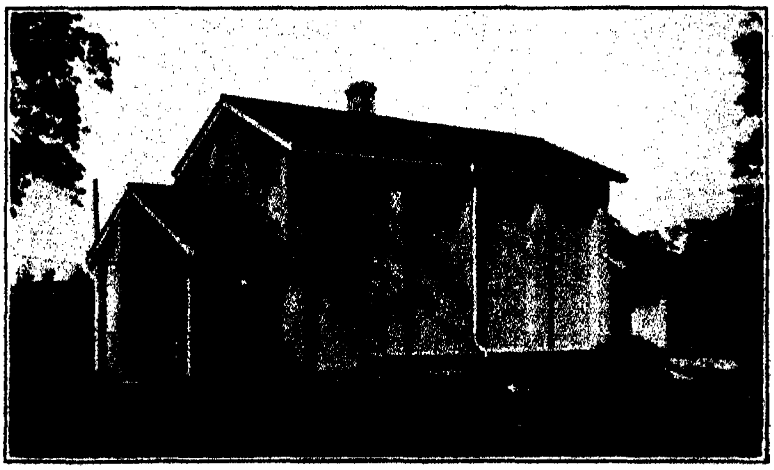

FIG. 1. Heating Laboratory at the Building Research Station, Garston.

The walls of the enclosure are heated or cooled by means of calcium-brine pumped through the embedded pipes which are spaced at 6-in. centres, and their mean surface temperatures are individually controlled to 0·1° F. by copper resistance-thermometers in conjunction with a sensitive relay system. Each wall surface is tested once in every 6 minutes and the controls then automatically raise or lower the temperature of the brine by means of specially designed modulating valves. Each modulating valve is driven by a Warren motor of 10 micro-horse-power.

The modulating valves, which are in the engine room, are fed with hot or cold brine from two insulated storage tanks of 200 and 400 gallons capacity respectively, and the necessary cooling is provided by a 4½-ton ammonia refrigerating plant which is automatic in operation.

Provision is made for the air in the test-room to be changed at rates up to four air changes per hour, with incoming air controlled at 40° F. or other suitable temperature.

In the programme of research which has been under consideration by the Heating and Ventilation Committee of the Department, on which are members of the Institution of Heating and Ventilating Engineers, emphasis has been placed upon the study of the conditions obtaining in a room warmed by extended surface heating and upon the investigation of floor and ceiling heating. It should perhaps be made clear that the new laboratory is specially designed for comparative work, and in the examination of floor heating, for example, it is clearly important to obtain an adequate comparison with other forms of heating. The most common form of central heating in use at the present time is by cast-iron radiators, and it is proposed, therefore, to adopt this as a standard of reference. This will not only provide a very convenient 'yardstick' but will also ensure that a substantial body of data will be obtained relative to this important type of heating.

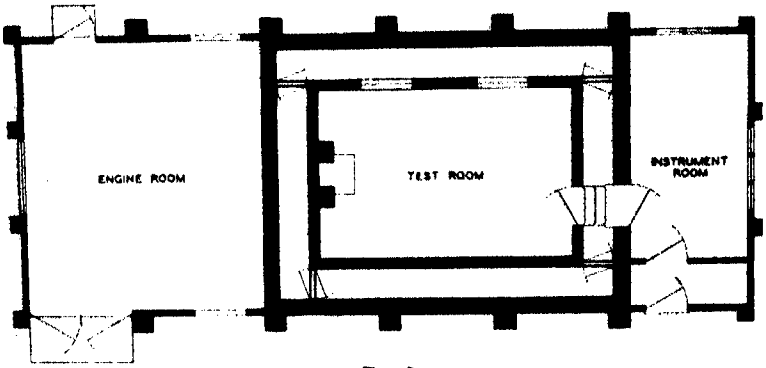

FIG. 2.

The new laboratory was open for inspection on the occasion of the annual visit of the Institution of Heating and Ventilating Engineers on July 22, when the members were received by Sir Raymond Unwin, the chairman of the Building Research Board, and the laboratory was formally opened by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research.

# Petroleum Fuels in Canada

DURING recent years, importers and consumers of petroleum fuels in Canada have furnished statistics of deliveries and uses of these products to the Department of Mines. Resulting from correlation of data supplied, a report has been prepared entitled "Petroleum Fuels in Canada" (Department of Mines, Bulletin 772; 1936) from which many interesting facts emerge.

Fuels are divided into four classes: fuel oil, kerosene, gasoline and petroleum coke; after summary tables showing quantities of each marketed in Canada during 1933 and 1934, and amounts distributed in each of the Provinces, the classes are studied separately. In 1934 more than 86 per cent of the total fuel oil was processed in Canadian refineries, the rest being imported; of this, 26 per cent was used for domestic heating, 23 per cent for industrial heating and power, more than 5 per cent for tractor fuel and more than 46 per cent for rail and water transportations. In the same year deliveries of kerosene were less than one eleventh of the volume of fuel oil and represented only one twenty-fifth of the total of petroleum fuels; actually only 36·2 million gallons were delivered in Canada, which is substantially less than was delivered in 1933; approximately 66 per cent of this was used for domestic heating, cooking and lighting, 24·5 per cent for tractor fuel and the remainder for other general uses.

Gasoline statistics included in the report are not strictly comparable with those of fuel oil and kerosene as they represent totals recorded by provincial tax departments of the Bureau and are interpreted subject to provisos as to amounts sold, etc., effective each year in each province. The gallonages supplied under each purpose use are therefore treated as estimates; nevertheless tables showing gasoline sales by provinces and quantities sold for motoring and other purposes are of interest as indication of destination of gasoline marketed in Canada.

Petroleum coke is used primarily as a fuel for domestic and industrial heating but is also a useful component of electric batteries, carbon lamps, crucibles and other manufactured articles; in 1934 approximately 57,000 short tons were sold for fuel, of which about 39,000 tons were destined for domestic heating and 18,000 for industrial heating.

# Problems of Translocation in the Plant

MESSRS. Mason, Maskell and Phillis continue their analysis of the movement of substances in the cotton plant in two papers published in the *Annals of Botany* (50, January 1936).

They first give their reasons for rejecting, on present evidence, either the Münch theory of mass flow in the phloem, or the theory of protoplasmic streaming, as providing a satisfactory mechanism for the movements that take place. Any view of mechanism must be influenced by definite information as to whether the phloem can function at the same time to deliver different materials in opposite directions, and these two papers describe the results of experiments designed to elucidate this point. The first paper (by Mason, Maskell and Phillis) shows that whilst very slow import of sugar into darkened

leaves is suggested by a formation of starch around the veins of such leaves when they remain in communication with illuminated foliage, yet the behaviour of such darkened leaves isolated by rings as compared with non-isolated leaves does not permit a safe conclusion that sugar may still move in whilst nitrogen moves out. Experiments with defoliated plants with tops in a humid atmosphere suggest that even when transpiration is so reduced, the nitrogen supply of the tops can still be adequately furnished by the xylem. An attempt by suitable ringing technique to demonstrate the movement of stored nitrogen from a basal adult region of the shoot upward into the growing tops when sugars were moving downwards was more promising, but the authors recognize that this stored nitrogen may still have moved down to the roots via the phloem and then upwards via the xylem if the nitrogen is released into the tracheæ in the root.

The later experiment, by Phillis and Mason, is regarded by its authors as giving a more definite answer on the point at issue. The cotton plants in this experiment were all ringed at the base, the basal leaves darkened and one series ringed between the basal region and the apical region. In this case when the plants were starved of all phloem mobile elements, the nitrogen travelled upwards in considerable amount from the basal to the apical region when these were not separated by a ring, whilst little or none entered the apical region when separated by a ring from the basal region.

As carbohydrate was still passing downwards from apical to basal regions in the same plant, these experiments are regarded as supplying good evidence that sugar and nitrogen may travel simultaneously in opposite directions through the phloem.

## Science News a Century Ago

### The British Association at Bristol

THE work of the British Association at its first Bristol meeting began on Monday, August 22, 1836, there being seven sections, namely, Mathematical and Physical Science, Chemistry and Mineralogy, Geology and Geography, Zoology and Botany, Medicine, Statistics and Mechanical Science. Among the contributors of papers were Brewster, Baily, Lubbock, Whewell, Hamilton, Babbage, Sedgwick, Buckland, Conybeare, Daubeny, Murchison, Dr. Hare of Philadelphia, Lardner, Snow Harris and Scott Russell.

The general meeting of the Association was held on the evening of August 22 in the Theatre, when some 2,000 persons were present. The Rev. Dr. Lloyd, Provost of Trinity College, Dublin, the retiring president, was in the chair, and in the course of his address said that among the purposes of the Association was that "by a more rapid and extensive communication of the lights of science as they are struck out, and by carrying these things home to the doors of all, to awaken to exertion those gigantic powers of mind, which are not confined to a few favoured spots; but which are everywhere to be found; and by establishing a more immediate and intimate communication among those engaged in kindred pursuits, to unite their exertions, as it were, into one simultaneous effort, and thereby to accelerate the progress of discovery in every line in which the mysteries of nature may be penetrated by the ingenuity and perseverance of man".

At the conclusion of his address, Dr. Lloyd resigned the chair to the Marquis of Northampton, whose first action was to invite some of the ladies present who were without seats to occupy places on the stage, although they were "by law excluded from the platform reserved for the General Committee". His Lordship congratulated the meeting on the great accession of members the Association had received at Bristol. "Here," he said, "were men of every shade of denomination and opinion engaged in one united effort in the cause of science and truth—eminent men from foreign lands, united by the glorious brotherhood of mind, were here assembled to cement the intellectual union of nations. This he regarded as a political result of the highest and most gratifying order. The moral effect of the Association arose from truth being the great object of all its labours."

### Death of Louis-Marie-Henri Navier

ON August 23, 1836, the eminent French engineer Louis-Marie-Henri Navier died in Paris at the age of fifty-one years. He was the son of a well-known lawyer of Dijon, where he was born on February 15, 1785. As a boy, owing to the death of his father, Navier came under the influence of his uncle Émilian-Marie Gauthey (1732–1806), an inspector-general of the Corps des Ponts et Chaussées. At the age of seventeen years, he entered the École Polytechnique and two years later the École des Ponts et Chaussées, the Government school for civil engineers founded in 1747 under the directorship of Perronet, and in 1804 directed by Prony. The mathematical training Navier received in these famous schools was reflected in all his later work. His first literary work was the publication of his uncle's "Traité de la Construction des Ponts", 1813. In 1819 he was made a professor of mechanics in the École des Ponts et Chaussées, and in the same year contributed to the Paris Academy of Sciences his "Mémoire sur la flexion des verges élastiques courbes", which was followed by his "Mémoire sur les lois de l'équilibre et du mouvement des corps solides élastiques", 1821, and his "Rapport et mémoire sur les ponts suspendus", 1824. In 1827 he investigated the general equations of equilibrium of an elastic solid, starting from an assumption as to the molecular constitution of matter.

While engaged in teaching and writing, Navier was responsible at the same time for the design of bridges, among which was a chain suspension bridge over the Seine at the Invalides in Paris, the bars for which he required to be tested to 11 tons per sq. in. Constructed in 1826, unfortunately one of the pylons failed, and the bridge had to be taken down. It was afterwards shown by Prony that the mishap was due to circumstances the designer could not have foreseen. The incident for a time had an unfavourable effect on Navier's reputation; but the esteem in which he was held was shown by his appointment in 1830 to the chair of analysis and mechanics at the École Polytechnique. Two years before his death he was given the rank of divisional inspector in the Corps des Ponts et Chaussées. His collected works were published after his death, and to the third edition of them Saint Venant added many valuable notes and corrections.

### Christoph Wilhelm Hufeland (1762-1836)

CHRISTOPH WILHELM HUFELAND, physician, author, editor and philanthropist, the centenary of whose death falls on August 25, was born at Langensalza in Thuringia on August 12, 1762, the son and grandson of court physicians at Weimar. After studying medicine at Jena and Göttingen, he qualified in 1783, his inaugural thesis being on the value of electricity in asphyxia. For the next ten years he remained in practice at Weimar, where he was brought into close contact with Goethe, Schiller, Wieland and Herder, as well as with members of the court. In 1793, he was invited by the Duke of Weimar to accept a professorship at Jena, and his lectures attracted considerable attention. In 1880 he succeeded C. G. Selle as royal physician at Berlin, where he became director of the Medico-Chirurgical College and senior physician to the Charité Hospital.

Hufeland was an extremely prolific writer, more than four hundred articles being attributed to him, but his best known works are "Makrobiotik" (1805) or the art of prolonging life, which was translated into every European language and passed through eight editions, and "Encheiridion Medicum; or Manual of the Practice of Medicine", of which six editions were published, an English translation appearing in 1842. Of the four medical journals which he edited, the best known is the *Journal der practischen Arzneikunde und Wundarzneikunst*, which he founded in 1795 and edited until his death in 1836, after which it continued until 1844.

Hufeland was an enthusiastic supporter of Jenner, and did much by his influence to diffuse the practice of vaccination throughout Germany, in addition to founding a vaccine institute at Berlin. He took an active part in the sanitary reorganization of Berlin, recommended the general use of warm baths and deprecated the abuse of spirits. In 1810 he founded a medical polyclinic, the first of its kind in Germany, for the treatment of the indigent poor, and for the next twenty-four years published annual reports of its activities. Finally, he did much useful work in combating popular errors concerning the Brunonian system of philosophy, mesmerism and phrenology. He was generally regarded as one of the noblest characters of his age.

### Sudden Deaths and Suicides in Russia

ACCORDING to the *Gazette des Hôpitaux* of August 25, 1836, official reports show that during the course of 1832, 405 persons, of whom 324 were men and 81 women, died a sudden death in St. Petersburg. In 1833 the figures were considerably higher; 569 such deaths (353 in men and 216 in women) being registered. Most of these deaths were the result of intemperance. It is rare in St. Petersburg, the report continues, as in all the large towns in Russia, for public rejoicing not to cause the death of a large number of individuals. In 1833, for example, 78 men and 24 women were picked up in the streets of the capital whose deaths were due to drunkenness and cold. It is a well-known fact that in Russia, those who are so imprudent as to fall asleep in the open air after excessive consumption of strong drink never wake up again. In the course of the triennium 1831-33, 104 suicides were committed in St. Petersburg. It was noted that young persons made use of firearms or sharp instruments almost exclusively, while old people preferred drowning or hanging.

# Societies and Academies

## Dublin

### Royal Dublin Society, June 23.

P. O'CONNOR: A contribution to knowledge of Irish fungi. A complete list of the fungi recorded by the author in Ireland during the past three years, with sites, dates and host plants and trees. A number of the species have not previously been observed in Ireland, and a few are new to the British Isles.

P. A. MURPHY and J. B. LOUGHNANE: A comparison of some Dutch and Irish potato mosaic viruses.

PHYLLIS CLINCH, J. B. LOUGHNANE and P. A. MURPHY: A study of the aucuba or yellow mosaic of the potato.

H. H. POOLE and W. R. G. ATKINS: The standardization of photo-electric cells for the measurement of energy. The cells and colour filters used for the measurement of daylight have been standardized by means of a standard filament lamp so as to enable the radiant power per square centimetre in various parts of the spectrum to be found in absolute units. The relatively low temperature of the standard source and the relatively large effect of errors in its assumed colour temperature reduce the accuracy of the results.

J. LYONS: The influence of chemical composition on the firmness of butter. The exceptional firmness of New Zealand and Australian butters as compared with Danish and Irish butters is attributed to the relatively low unsaturated fatty acid content and high stearic acid content of the former.

J. A. C. TEEGAN: The comparison of $\gamma$-ray intensities from radium preparations. A valve method of measuring the ionization current allows the natural leak to be compensated, and is very rapid and convenient for routine measurements.

## Paris

### Academy of Sciences, July 6 (*C.R.*, 203, pp. 1-136).

LUCIEN CAYEUX: The reticulated structure of the silica observed in pre-Cambrian phtanites and Suessonian phosphates.

MARIN MOLLIARD: The yield of green plants as a function of the proportion of oxygen in the atmosphere. With the radish as the experimental plant, the maximum yield was obtained with an atmosphere containing 5 per cent of oxygen, and the high yield coincided with a more intense green. It is suggested that, with proportions of oxygen above 5 per cent, some oxidation of the chlorophyll pigment may take place.

SERGE WINOGRADSKY: Researches on the morphology and physiology of *Azotobacter* in the soil.

PIERRE LEJAY: New determinations of the acceleration of gravity in France. A table is given showing the values of $g$ for 57 new stations.

MAURICE NICLOUX: The identification of ethyl alcohol.

MLLE. ELISABETH LUTZ: The solutions of the equation $y^2 = x^3 - Ax - B$ in $\mathfrak{P}$-adic bodies.

ANDRÉ WEIL: The $\mathfrak{P}$-adic elliptic functions.

WOLFGANG DŒBLIN: The discrete chains of Markoff.

JEAN-ANDRÉ VILLE: The notion of the collectif.

E. J. GUMBEL: Floods and the theory of the greatest value.

CHRISTIAN PAUC: Some local properties of Euclidian continua.

JULES GÉHÉNIAU: The generalization of Th. De Donder of Hilbert's theorem of independence.

S. MANDELBROJT and NORBERT WIENER: Lacunous Fourier's series. Direct theorems.

CHARLES PLATRIER: The problem of Barré de Saint-Venant in a homogeneous medium which is deformed starting from a state of constraint.

NICOLAS STOYKO: The irregularity of the earth's rotation. From a comparison of data obtained at Charlottenburg (0·35 sec.) and at Paris (0·39 sec.) over the period October 1934–August 1935, there appears to be a retardation in the rotation of the earth of 0·37 sec.

RENÉ DUGAS: A definition of the validity of quantic mechanics.

PIERRE VERNOTTE: The theoretical dimensions of the cellular vortices of Bénard.

LÉON DUBAR: The influence of the gases of the atmosphere on the electrical conductivity of cuprous oxide. After a preliminary heating in a vacuum, contact with oxygen causes a regular increase in conductivity. This increase is removed by admitting water vapour.

M. LAMBREY and S. KRAUTHAMER: The abnormal combinations of frequencies of conversion values.

EMILE PIERRET: The properties of triodes with large diameter plate in very high frequencies. Triodes with plate of large diameter can be used for the production of oscillations of very short wave-length, and the frequency can be varied between certain limits as a function of the voltage of the plate. This arrangement is specially useful in measurements of dielectric constants.

J. HENRION: Dielectric losses in an alternating field of high frequency and molecular dimensions. The experimental results given show that the method can be advantageously applied to the determination of mean molecular dimensions.

J. SWYNGEDAUW: A new electro-chemical method of preparing proteins in the isoelectric state.

THÉODORE V. IONESCU: The true periods of vibration of ionized gases in the magnetic field.

JACQUES STOHR: An arrangement with self-induction circuit for determining the derivative with respect to time of a function represented by an electric current.

MARCEL LAPORTE and FRANÇOIS GANS: The physical photometry of tubes containing luminescent gas.

ROBERT BOSSUET: The search for the alkaline metals in natural waters. The waters examined came from Corsica, Algeria, Tunis and Madagascar. The results are classified under two headings: those containing all five alkali metals, and those not containing cæsium.

*(To be continued.)*

## Brussels

Royal Academy (*Bull. Classe Sci.*, No. 5, 1936).

L. GODEAUX: Cyclical involutions of the third order and genus one belonging to an algebraic surface.

P. FOURMARIER: Some observations on slaty cleavage in the Palæozoic regions of north Devon and north Cornwall.

E. W. BETH: Proof of a theorem concerning the principle of the excluded third.

M. BARZIN: Note on M. E. W. Beth's proof.

G. HIRSCH: Logical foundations of the theory of probabilities.

B. GAMBIER: Study of the cubic surfaces which can possess Eckardt points.

L. FALLA: An involution of the second order, the groups of which belong to the radii of a linear complex.

YVONNE DUPONT: Theory of elastic deformations in space-time.

J. VAN MIEGHEM: Intrinsic form of the conditions of compatibility. Application to the calculation of potential discontinuities.

M. DÉSIRANT and A. MINNE: Researches on the 'fluctuation bands' of the diatomic vapour of tellurium.

## Geneva

*Society of Physics and Natural History, June 4.*

ARNOLD PICTET: The heredity of a novelty in fur: the silver guinea pig.

CHARLES BAEHNI: A case of generic convergence in the Iridaceæ. Normal *Geissorhiza* and abnormal *Antholysa*.

PAUL ROSSIER: (1) The calculation of the apparent diameter and effective wave-length of stars. (2) The effective photographic wave-length. (3) The width of the lines of stellar hydrogen.

FERNAND LÉVY: The local distribution of the pressures in an elastic medium.

L. W. COLLET and ED. PAREJAS: (1) Contribution to the study of the Salève Tertiary. (2 and 3) The region comprised between Esserts and Usses, and a general survey.

June 18.

A. MERCIER: The relations between the spinorial and Clifford magnitudes.

R. WAVRE: The four logarithmic potentials of a circumference.

F. BEER: The extension of the Hadamard-Schmidt theorem to the case of the logarithmic potential created by a real body in a complex domain.

K. H. MEYER and BRENTANO: Researches on maize starch.

E. C. G. STUECKELBERG: The absolute electromagnetic potential as a new property of light.

July 2.

P. WENGER, CH. CIMERMAN and G. TSCHANUN: The electrolytic microdetermination of zinc, and its application to brass.

CH. CIMERMAN and P. WENGER: The volumetric microdetermination of zinc.

E. PERROTET and B. SUSZ: The Raman spectra of the *cis* and *trans* isomers of isoeugenol.

S. FRIED and B. SUSZ: Note on the Raman spectrum of the trimethyl ether of oxyhydroquinol.

P. ROSSIER: Discussion of the spectrograms of the *B5* stars.

J. BUFFLE: Observations on the surface waters and deep waters of the canton of Geneva.

DOM ZIMMET: (1) The use of the nickel-nitroprusside reagent as an external indicator in the determination of reduced glutathione with iodine. (2) The amount of glutathione in some oil-producing plants: walnut, Brazil nut, hazel nut, almond and peanut. (3) The biological analogy between the bile acids and the sterols. The influence of the bile salts on the growth and morphogenesis of tadpoles.

## Rome

**Royal National Academy of the Lincei**

(*Atti*, 23, 3–92; 1936).

U. Cisotti and A. Masotti: Ballast effects in space.

G. A. Maggi and B. Finzi: Conditions at the wave-front and harmonic electro-magnetic waves.

E. Bortolotti: Non-linear relations: geometry of a system of equations with partial derivatives of the second order. Preliminary (1).

O. Chisini: Branching curve of multiple planes.

G. Palamà: Two new generalizations of Vandermonde's determinant.

B. Caldonazzo: Free regulating source in the problem of a lamina.

G. Lampariello: Asymptotic irrotational motion of every stationary current of a perfect fluid subjected to conservative forces.

G. D. Mattioli: Second form of the equations of turbulence according to the hypothesis of a single direction of transport (1). Energetic equation of turbulence and conditions of integration of indefinite equations (2).

G. Nebbia: Tracing the shapes of gradually varying permanent liquid currents.

E. Jolles: Derivatives of the azoxy-carboxylic acids.

C. Antoniani and A. Spica Clerici: Glucidic metabolism of the mammary gland *in vitro*.

M. Fenoglio: Vogesite from Ginepro (Elba).

A. Messeri: Primary organizing sieve tissue of the secondary cambium.

G. Negodi: Contribution to the cariology of *Calendula* (L).

M. Ventura: Some embryological data of *Sapium sebriferum* (L.), Roxb.

(*Atti*, 23, 95–159; 1936).

G. Andruetto: New expression for the total curvature of a surface (1). Geodetically parallel lines and hyper-surfaces (2).

E. Bortolotti: Non-linear relations: geometry of a system of equations with partial derivatives of the second order. Intrinsic properties of the system (2).

U. Broggi: Determinant functions and polynomials of Laguerre.

L. Crocco: New function of a current for the study of the rotational motion of gases.

G. Krall: Equations of vibratory motion of a bridge traversed by inert and pliant loads (1). Limits for the vibrations of any bridge traversed by mobile loads with uniform motion (2).

A. Masotti: Planar motions produced from two vortex sources.

A. Baroni: Sulphide, selenide and thioselenide of thiocyanogen. The preparation of $Se_2(CNS)_2$, of $SeS(CNS)_2$ and of $S(CNS)_2$ is described. All these substances polymerize readily at ordinary temperatures.

O. Bottini: Thermal decomposition of $NH_4$-clays.

E. Parisi and G. de Vito: Contribution to the knowledge of the ripening of cheeses. Polypeptides containing phosphorus (2). By the action of proteolytic enzymes fragments of relatively low molecular weight, which contain practically all the phosphorus of the original substance, are broken off from the casein molecule.

M. Benazzi: Influence of the cephalic region on the movement and sensitivity of tricladic Planaria.

T. Perri: Growth of the crystalline in anurid Amphibia (2). Experiments on *Rana esculenta*.

# Official Publications Received

## Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records No. 11 (Timber Series No. 8): The Properties of Home-Grown Oak. Pp. ii+14. (London: H.M. Stationery Office.) 6*d*. net. [307

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on July 28th, 1936. Pp. 6. (London: Empire Cotton Growing Corporation.) [307

The National Institute of Poultry Husbandry: Harper Adams Agricultural College. Bulletin No. 12: Turkey Production. By A. J. Macdonald and Margaret S. Miller. Pp. 8. (Newport, Shropshire: Harper Adams Agricultural College.) 3*d*. [307

Anarchy or Peace? By Lord Davies. (Series D/No. 10/Int.) Pp. ii+17. (London: The New Commonwealth.) 9*d*. [317

City of Leicester Museum and Art Gallery. Thirty-second Report to the City Council, 1st April 1935 to 31st March 1936. Pp. 32+2 plates. (Leicester: Museum and Art Gallery.) [317

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1935. Pp. 27. (London: H.M. Stationery Office.) 6*d*. net. [317

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 36: The Chemical Constituents of Lichens found in Ireland—*Buellia canescens*, Part 2. By P. A. Spillane, Dr. J. Keane and Dr. T. J. Nolan. Pp. 333–343. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*. [48

## Other Countries

Transvaal Museum. Report for the year ended 31 March 1936. Pp. 23. (Pretoria: Transvaal Museum.) [287

Sudan Government: Agricultural Research Service: Chemical Analytical Section. Report of the Government Chemist for the Year 1935. (Chemical Section: Publication No. 78.) Pp. 23. (Khartoum: Agricultural Research Service.) [297

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 18, No. 1 (Mathematics No. 18): On a Pair of Surfaces mutually Related (3) (4). By Sôzi Matumura. Pp. 19. Vol. 18, No. 2 (Mathematics No. 19): Über Flächen und Kurven (16), Über Eilinien und Eiflächen; Beiträge zur Geometrie der Kreise und Kugeln (16), von Sôzi Matumura. Pp. 21–74. (Taihoku: Taihoku Imperial University.) [307

Bernice P. Bishop Museum. Bulletin 137: Dinoflagellates of the Coastal Waters of the Western Pacific. By Anton Böhm. Pp. 54. Bulletin 138: Ethnology of Futuna. By Edwin G. Burrows. Pp. iv+239+11 plates. Bulletin 139: Marquesan Insects: Environment. By A. M. Adamson. (Pacific Entomological Survey: Publication 9.) Pp. ii+73+8 plates. Bulletin 140: Report of the Director for 1935. By Herbert E. Gregory. Pp. 52. (Honolulu: Bernice P. Bishop Museum.) [317

Bernice P. Bishop Museum. Occasional Papers. Vol. 11, No. 15: Native Trade in Southeast New Guinea. By Laura Thompson Tueting. Pp. 43. Vol. 11, No. 16: Effect of X-Rays on Regeneration of Chelipeds of *Atya bisulcata*. By Charles Howard Edmondson. Pp. 15. Vol. 11, No. 17: Society Islands Pounders. By Henry Silverthorne. Pp. 17. Vol. 11, No. 18: Check List of the Serphoidea, Bethylidæ and Anteonidæ of Oceania. By Robert Fouts. Pp. 15. Vol. 11, No. 19: The Hawaiian Silverswords; Systematics, Affinities and Phytogeographic Problems of the Genus Argyroxiphium. By David D. Keck. Pp. 38. Vol. 11, No. 20: Contribution to the Mosses of Fiji. By Edwin B. Bartram. Pp. 30. Vol. 11, No. 21: Notes on the Flora and Fauna of Lehua and Kaula Islands. By Edward L. Caum. Pp. 17. Vol. 11, No. 22: Two New Species of Terminalia from the Austral Islands and Mangareva. By A. W. Exell. Pp. 4. Vol. 11, No. 23: A New Species of Schiedea. By Edward L. Caum and Edward Y Hosaka. Pp. 5. Vol. 12, No. 1: *Review of the Genus Orochlesis* (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 19. Vol. 12, No. 2: Amarantaceæ of Southeastern Polynesia. By K. Suessenguth. Pp. 10. Vol. 12, No. 3: Baridinæ of Southeastern Polynesia (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 8. (Honolulu: Bernice P. Bishop Museum.) [317

Bernice P. Bishop Museum. Special Publication 26: Proceedings, Hawaiian Academy of Science, Tenth Annual Meeting, 1934–1935. Pp. 21. (Honolulu: Bernice P. Bishop Museum.) [317

Field Museum of Natural History. Anthropology Leaflet 33: Archæology of South America. By J. Eric Thompson. Pp. 160+12 plates. (Chicago: Field Museum of Natural History.) 75 cents. [317

U.S. Department of Agriculture. Circular No. 387: Distribution of the Argentine Ant in the United States and Suggestions for its Control or Eradication. By M. R. Smith. Pp. 40. (Washington, D.C.: Government Printing Office.) 5 cents. [48

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 156: The Optimum Sugar Cane Planting Date in Egypt. By Arthur H. Rosenfeld. Pp. 13+9 plates. 3 P.T. Bulletin No. 179: Water-Weight-Changes in Export and Country Bales. By Dr. W. Lawrence Balls. Pp. 27. 3 P.T. (Cairo: Government Press.) [48

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1935. By J. P. Mead. Pp. iii+60+4 plates. (Kuala Lumpur: Government Printer.) 50 cents; 1*s*. 2*d*. [48

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. Notes on some South Asiatic Species of the Genus Cyornis. By Erwin Stresemann and Rodolphe M. de Schauensee. Pp. 337–351. (Philadelphia: Academy of Natural Sciences.) [58

League of Nations. The Problem of Nutrition. Vol. 3: Nutrition in various Countries. (Series of League of Nations Publications. II. Economic and Financial, 1936. II.B.5.) Pp. 271. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 5*s*. 6*d*. [58

Union of South Africa: Department of Agriculture and Forestry. Bulletin No. 156: Seasonal Variations in the Freezing Point of South African Milk. By Dr. L. Denis-Lester. (Chemistry Series No. 142.) Pp. 14. 3*d*. Science Bulletin No. 153: The Composition of Pineapples. By J. C. Bodenstein. (Chemistry Series No. 146.) Pp. 14. 3*d*. (Pretoria: Government Printer.) [58

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# International Economics and Social Reconstruction

THE narrow outlook which continues to characterize much of the controversy regarding sanctions, the refusal to face the implications of collective security, and the disposition to blame a mere organization such as the League of Nations for failures due to lack of courage and foresight on the part of statesmen in using the machinery ready to their hand, should dispel any optimism that we are beginning to grasp the essential principles upon which the future well-being of mankind must be constructed. We may well doubt that there is sufficient political sense and stability in Europe or Asia to make world recovery possible at all. To those who maintain that our whole civilization is slipping into disintegration and dissolution from which all our mastery of the material universe is impotent to preserve it, a satisfactory answer is not readily found.

Reasons such as these, and the way in which the continued difficulties experienced by our own and other Governments in handling international affairs betray lack of capacity for real leadership and foresight, may well lead to misgivings as to the future in spite of the undoubted fall in unemployment and increase in industrial employment and trade. How well-founded are such misgivings is indicated by the admirable survey of world economic and social conditions provided by Mr. Harold Butler, Director of the International Labour Office, in his Annual Report*. It is clear from this survey that no certain answer can yet be given to the question whether the past year should be regarded as marking the emergence of the world into the flowing tide of recovery or as merely an interlude of mitigated depression.

* Report of the Director, International Labour Office, Geneva, 1936.

On the credit side of the economic balance sheet must be set a gradual improvement in prices and a continued decline in unemployment. In many countries, the general index of industrial production has moved steadily upwards; but in so far as this industrial prosperity is founded on the expansion of armaments, which notoriously is taking place in the principal industrial countries, it is hollow and unusual as well as sinister. The manufacture of arms adds nothing to national wealth, and the economic consequences of rearmament must be set in the scale against the apparent sign of economic revival. The universal alarm and anxiety which accompany intensive competition in armaments check the expansion of healthy trade and investment, and block the path of normal recovery.

The armament situation itself is thus reason enough for some misgivings about the present situation. The slight improvement in the volume of international trade, and the extent to which economic nationalism continues to hold the field, are other reasons for anxiety. Confidence in foreign investment is still lacking, and the major obstacle to the re-birth of confidence is the fear of war, imminent or not remote; and economic recovery is an impossible dream until this fear of another and more catastrophic collapse of the whole international political system has been dispelled.

Given a general will to seek that end in a constructive and co-operative spirit, the task is not yet impossible in spite of its increased difficulties; but it calls for the display of statesmanship of the highest order. It must be realized that the most radical flaw in the recent peace settlement was the failure to ensure economic and social equilibrium. Territorial claims and armament programmes are the symptoms—not the causes—of our present

condition. The roots are to be found in actual or threatened impoverishment, declining standards of life, insecurity for the future of themselves and their children which darkens the outlook of the present generation in so many countries. The question of peace can no longer be discussed apart from that of social justice.

On such grounds as these, Mr. Butler is led to a point of view which many scientific workers have reached, from their survey of the possibilities of the applications of science being utilized to raise the general standards of and amenities of human life, and to assist in the distribution of the economic resources now at our disposal. No longer can we think of life in terms of sub-divisions only. Artificial barriers which hamper our thought about men in society must be broken down and a synthesis of all the social sciences achieved which will permit a true notion of the structure and possibilities of society, just as it is only by a synthesis of all the sciences concerned with man and his environment that we can understand his nature.

Mr. Butler's brief summary of the immediate problems of social reconstruction which call for consideration has points in common, such as housing, with those which in Great Britain are already receiving the attention of such groups as P.E.P. (Political and Economic Planning), or nutrition, on which scientific workers have done much to provide a basis for action. Mr. Butler refers to the way in which these questions are linked to those of international trade and finance. The question of raw materials is similarly linked and is not even mainly a colonial problem. The countries which have real difficulties in procuring their supply of raw materials are those which have imposed restrictions in dealings in foreign exchange, due to their monetary or commercial policies. The problem cannot be divorced from the whole question of restrictions on commerce, including the question of the 'open door' in colonial territories which are large providers of certain raw materials.

These problems in themselves raise broad questions of colonial policy, not only in regard to raw materials but also in regard to labour and migration. The need for investigating such problems is now becoming generally admitted, and they can only be dealt with on practical lines if account is taken not only of general principles, such as are embodied in the Mandates Article of the Covenant of the League of Nations, but also of the conditions and requirements of each particular case. Not the least untoward consequence of Italian aggression in Abyssinia is the way in which it has enhanced the difficulties of an impartial and adequate treatment of questions which were already sufficiently thorny.

Last and most important of all in the programme of reconstruction is the problem of liberating commerce from the restrictions which have been imposed upon it by nationalist economic policies or on account of currency disorders. From whatever angle we approach the problem of reconstruction, the only path leading to its solution is that of closer international intercourse. The doctrines of nationalism and self-determination may within limits be beneficial and stimulating in the field of politics and culture, but in the field of economics they are fatal. Economic nationalism in its recently developing forms is incompatible with economic stability and therefore with the peace of the world.

The only way out of our troubles is, therefore, to restore so far as possible exchange of goods, services, money and population on which pre-War prosperity was founded, and which the rapid progress in means of communication has made all the more imperative. The new world economy to be built up, however, must take account of all the developments which have taken place since 1914. The great internal transformation in industry and agriculture cannot be set aside without causing still further confusion and upheaval. They necessitate a complete readjustment of method, but the ultimate objective is unchanged.

Mr. Butler gives us once more a survey which commends itself to the scientific worker alike for its presentation of the facts on a broad canvas free from the distortion of material or party bias as for its insistence on the necessity of viewing life as a whole. Economics cannot be separated from ethics, social justice from material well-being, or social and ethical aspirations from political activities. Peace itself is not possible without social justice between nations and between individuals, and only through an equitable organization of the world's economic life can peace and justice and freedom be made secure.

These views to-day are in danger of becoming platitudes, though they touch the quality and direction of scientific life and thought as of every other intellectual or physical activity. It is only as creative thought is brought patiently and impartially to bear on these questions that we can

hope to find the lines of a solution; and the major question is whether sufficient moral and social pressure can be mobilized in support of constructive policies in which science plays its fitting part, before the reactionary forces of militarism and economic rivalry and autarchy bring the whole fabric of our civilization to collapse.

The root question behind this appeal for world co-operation is the choice between freedom and slavery of the spirit. Freedom of thought and speech, belief and investigation, subject only to the recognition of the same liberty on the part of others, is exactly what is threatened by the new tyrannies which, through their militarism and economic nationalism run mad, seek often in subtle ways to reduce the citizen to a soulless unit, to moral and intellectual servitude. The perpetuation of economic antagonism and military rivalries is as grave a danger to scientific thought and investigation, upon which so many of its material achievements are based, as it is to the continuance of our material civilization.

# Manifolds of Plenary Space

**Intrinsic Geometry of Ideal Space**
By Dr. A. R. Forsyth. Vol. 1: pp. xxvi+553. Vol. 2: pp. xiv+655. (London: Macmillan and Co., Ltd., 1935.) 2 Vols. £6 6s. 0d. net.

IT is desirable to give the reader immediately an idea of what is an ideal space and its intrinsic geometry. Prof. Forsyth writes: "The present work is occupied with investigations of those intrinsic properties and differential measures of geometrical amplitudes which are connected with the corporate characteristics and the organic constituents of the amplitudes". Hence we see, if we do not know what is an ideal space, we know at least that we can substitute the word "amplitude" for it; and instead of "intrinsic" we can use "corporate" and "organic". That is all. We must seek an interpretation of these mysterious words going through the 1248 pages of this work. Before we can do that, we must become acquainted with some other words: plenary uncurved or homaloidal (Euclidean space); flat and block (Euclidean spaces of dimensions three and four); amplitude (manifold); regions and domains (manifolds of three and four dimensions); tilt and coil (third and fourth curvature); gremial, orbicular, and globular curvatures; and other curiously used words.

Passing over Eleusinian statements like this: "The homaloidal space is free from all native measures that can modify the geometrical character of included figures: its standardising influence is impartially neutral", we begin to examine the contents.

Section I, after an introduction where we discover the identity between homaloidal and Euclidean space (How can that be? Was it not free from any native measure?) and where we find the old Frenet equations, gives a sketch of Riemannian geometry (geodesics, Riemann's curvature), with a mixture of properties not belonging to this geometry but to the ordinary Euclidean geometry of the manifold (as embedded in a Euclidean space). Such are the researches on the locus of the centres of first curvatures of geodesics of a manifold $V_n$ concurrent at a point: the cases when the dimensions of the plenary space (Euclidean space embedding the $V_n$) are $n+2$ or $n+3$ are discussed. In this second case two subcases arise; but no hint is given of the projective ground on which this distinction stands. Neither is there any suggestion of what may happen when that space has more than $n+3$ dimensions, although the number of possibilities is finite.

With Section II begin the limitations of the field of research; the author restricts his studies to surfaces (Section II), regions (Section III) and domains (Section IV) and to their subamplitudes. Here also we find properties of Riemannian character (geodesics, Riemannian curvature, Levi-Civita's parallelism, minimal surfaces and regions) scattered in different chapters, according to the dimensionality of the amplitude; also, when they are independent of it, mixed up with properties relating the amplitude to its Euclidean space. There is a wealth of particular results (new or not, that is difficult to state from quotations in the book), but no general idea. It is a kind of empirical 'going on', step after step, with apparently no goal to be reached. The method of attack has also the same empirical character: it would certainly be inadequate for a research of broader frame.

Now some selected topics. Section I contains some theorems which can be summarized as follows: the second, third and fourth normal of a geodesic of an amplitude (at a point) lie in the tangent homaloid of the amplitude. This is a serious mistake, and no calculations are necessary

to check it. In fact, not only is the reasoning on which it is established evidently wrong, but, should it be true, it would lead to the amusing conclusion that the geodesics of any surface whatever belong to spaces of three dimensions! This mistake is of no little moment: it invalidates many results in different sections of the book.

Section II opens with the following question: Is it possible to find a lower limit to the dimensionality of the Euclidean space (plenary homaloid) containing a surface with a given arc-element? The answer, given by Darboux in 1872, and referred to in all standard treatises on the subject (like Darboux's and Bianchi's) is in the affirmative. It is always possible to construct such a surface in a space of three dimensions by integrating a Monge-Ampère equation and by quadratures. Prof. Forsyth's answer is in the negative*: it is true that he speaks of an upper limit, but what he means (as can be seen from the discussion) is a lower limit. This is all the more reason that a search for an upper limit has no value, it being evident that, given a surface in a 3-space, surfaces with the same arc-element can be found in a space with greater number of dimensions. Prof. Forsyth seems struck by the example he gives of a surface in a space with an infinite number of dimensions: there is nothing surprising in it, the dimensionality of the space having nothing to do with the arc-element of the surface (it is not a Riemannian character).

Another topic to be mentioned—and this will be the last one—is the statement, often repeated and invalidating many results, that when a certain determinant vanishes (see, for example, vol. 1, p. 369) or, what is the same thing, when the first and second derivatives of the co-ordinates of a point of a surface are not linearly independent, the surface lies in a quadruple homaloid. To make the mistake more curious, the example given before of a surface belonging to a space with infinite dimensions contradicts the last statement. But this is only one example, and the simplest one, of the contradictions which arise when the projective characters of the manifold are not considered. I have emphasized many times the fact that, when studying the differential properties of a given order (of differentiation), the basic element to be considered is not the dimensionality of the space in which the manifold is immersed (which may also be infinite, with no danger) but the dimensionality of certain osculating spaces (as I call them) projectively connected with the manifold.

The author describes his book as an adventure into the realm of investigating manifolds (not curves or hypersurfaces) existing in a plenary space. Thirty years ago, E. E. Levi (who is not quoted in this work) entered the same realm, harvesting the first results (for two-dimensional surfaces) and showing its difficulties. More than twenty years ago, I tackled the problem again, and conceived the idea of Riemannian geometries of higher species ("Geometrie Riemanniane di specie superiore". *Mem. R. Accad. d'Italia*, 1935), showing that the differential properties of a given order $r$ of a manifold (whatever its embedding space may be) can be described in terms of $r$ differential forms of the first order and of $2, 4, \ldots, 2r$ degree. But the step was not easy. To fill the gap it was necessary to build up the projective differential geometry of manifolds, or more exactly of linear partial differential equations. In the meantime, other investigators have taken part in the work, as Vitali, Enea Bortolotti, Burstin, Duschek and Meyer; apparently passing over all this work, Prof. Forsyth has followed his own way.

E. BOMPIANI.

* The correct result is given in a corrigenda sheet which has been issued since publication of the book.

# Sea Urchins

**A Monograph of the Echinoidea**

2: Bothriocidaroida, Melonechinoida, Lepidocentroida and Stirodonta. By Th. Mortensen. Text. Pp. vi+647. Atlas. Pp. ii+16+89 plates. (Copenhagen: C. A. Reitzel; London: Oxford University Press, 1935.) 2 vols., 140*s*. net.

THIS monograph attracts a review, for it exhibits features of a distinctly novel nature and it approaches perfection as near as can be. The animals are the box-like sea-urchins, starfishes with radiating segments and brick-like walls (tests) decorated with spines and fine sculpturing. They walk by outpushings of fine tubes (tube-feet) with terminal sucking-disks arranged in five rays, such as cause starfish to be of unique personality. They belong to Mortensen more than to anyone else, for he has pursued the living forms in most parts of the world. Here, his study of the urchins' habits, food and ecology was antecedent to that of their classification, and he thus by analogy can tell us much of the life of the extinct forms. Of the latter there is a long series from the Palæozoic, and it would seem

probable that these animals have never been less numerous either in genera and species or in individuals than they are to-day. Thus the relatively deep-living Salenidæ had eighty-five species in the Cretaceous as compared with only twelve species to-day, but all the extinct forms were not deep-living.

The first animal here considered, *Bothriocidaris*, was formerly regarded as the ancestor of all sea-urchins, but more ancient forms are now known, and Mortensen evidently places it here to avoid making another phylum. He supposes that it must have ingested food through the mouth, probably the adoral spines and tube-feet helping as in the living spatangoids. Judging by the deposits where it occurs, it lived in shallow reef-pools, which, according to the indications furnished by its test, cannot have been exposed to strong wave-action. It is this thought of the fossil forms as once alive and playing their parts on the ocean floor which makes this monograph so illuminating, its animals far more than mere dates in a stratigraphical series and its living forms the few survivors of a long ancestry.

Only three divisions (Melonechinoida, Lepidocentroida and Stirodonta), besides Bothriocidaroida with its single genus, are monographed. They contain 22 recent and 116 fossil genera. All the genera are described, while in addition the 84 existing species are fully considered in respect to their anatomy, colour, occurrence and, so far as possible, their ecology; the text illustrations of the anatomy form a feature of great utility. The same technique is applied to the fossil genera, the anatomy of which is illustrated while their affinities are considered. Many of the species are referred to, but it is beyond the author's scope to consider all the described fossil forms. Added to the monograph is a volume of plates of high quality.

The whole is of great credit not only to Mortensen but also to Denmark and to the managers of the Carlsberg Fund, whose financial aid alone made possible the printing of this luxurious publication, which it is a joy to handle. J. S. G.

# Negroes and Pygmies

**My Pygmy and Negro Hosts**
By Paul Schebesta. Translated from the German by Gerald Griffin. Pp. 287+31 plates. (London: Hutchinson and Co. (Publishers), Ltd., 1936.) 18*s*. net.

FATHER PAUL SCHEBESTA, whose intimate knowledge of the pygmy problem, acquired in the Far East as well as in Africa, transcends that of any living ethnologist, has now produced a sequel to "Among Congo Pigmies". In this he supplements his earlier work on the Congo pygmies by an account of the Batwa of Ruanda and the Bachwa of the Equatorial Province, who, if not all pygmies, at least merit the title of half-pygmies. More important, however, for his present purpose, are the tribes of full stature with whom he came into contact on his travels in 1929 and the two succeeding years.

Interesting for the ethnologist as must be the comparison of the material relating to the pygmy peoples given here with that of the previous book, it will probably appear to most readers that the author has displayed sound judgment in devoting the larger share of his attention to the tribes other than pygmy. For one thing, this material is essential for an understanding of the ethnological background, in view of the close relation, almost a symbiosis, between the pygmy and his taller neighbour, while in the second place, the culture of these peoples is both intrinsically interesting, and for the most part has not previously been described. Witchcraft, cannibalism and tribal history afford the author a rich field for description. It may be hoped that material for a fuller and more systematic analysis of the last named will be forthcoming later. Some further details, too, of the evidence upon which is based the suggestion of a surviving influence from Ancient Egypt will be welcomed.

The author was much impressed by his visit to the Royal Court of the intrusive Batutsi of the mandated territory of Ruanda, in which, as he points out, there are certain close resemblances to the court of Uganda. He was admitted to the presence of the Royal Mother—a privilege formerly denied to the foreigner, and evidently resented. Shortly after, the dynasty was deposed by the Belgian authorities.

The narrative offers innumerable tempting paths which would lead to discussion, such as, for example, the association of initiation ceremonial with a cannibalistic 'leopard' society among the Babali, where also initiation takes the place of circumcision, universal among the other tribes. The author himself was responsible for the discovery of a secret 'leopard men' society and its association with cannibalism among the Babali.

At the present moment, when African colonies and mandated territories are much under discussion, Father Schebesta's final chapter, in which he deals with the relations of black and white in the Congo, will be found to contain much that is pertinent. Belgium, he points out, is intensely proud of the possession of the Congo and has made immense sacrifices for its benefit. Since the Great War, a complete change has taken place in the spirit of the administration, and every effort has been directed towards the benefit of the natives. In the main these efforts have taken two directions —the building of roads and the formation of an administrative organization for the government of the natives in accordance with their own cultural ideas. As the author points out, the making of roads has conferred no benefit on the natives, while imposing on them a heavy burden of upkeep; and the system of headmen or *chefs de section* has been applied without discrimination. In certain instances it was applied to peoples to whom it was not adapted; in others the headman, as happened also at times in British mandated territory, was merely a figure-head, because the real native rulers, the spiritual chiefs, remained in the background and continued to receive the peoples' allegiance. Apart from the author's criticisms, there is evidence here and there in his narrative that the administrative system lacks the necessary basis of a scientific study of native institutions, which has been recognized elsewhere as a necessary preliminary, however superficial it may have been in practice, owing to lack of time or other impeding conditions.

# New Ornamental Trees and Shrubs

**Trees and Shrubs hardy in the British Isles**
By W. J. Bean. Vol. 3. Pp. xiv+517+64 plates. (London: John Murray, 1933.) 36*s*. net.

DURING the planting season, those of us who wish to make our gardens more attractive by the addition of flowering shrubs or trees, scanned nurserymen's catalogues for some of the more showy and less commonly seen species, so many of which have been introduced in recent years. The wanderings of Forrest, Kingdon Ward, Wilson, Farrer, Comber and Rock have greatly increased the possibilities for variety. Now that the new introductions have been tested as to adaptability to our climate, at Kew, Edinburgh, Wisley and elsewhere, seeds and plants of those which have proved satisfactory are becoming available for distribution, at a moderate price, to gardens with only limited space.

Those who are looking for new and interesting species would be well advised to study carefully the third volume of Bean's "Trees and Shrubs hardy in the British Isles". This is a supplementary volume to the first two, which were issued in 1914; it has been written with the same care and precision, and that unrivalled personal knowledge of the plants themselves and their requirements, which are so characteristic of all Mr. Bean's work. It comprises 517 pages and includes 64 full-page illustrations from photographs by such well-known lovers of trees as Lieut.-Colonel Stephenson-Clarke, Dr. Wilfred Fox and the late Dr. E. H. Wilson, and others by R. A. Malby and Co. These, in themselves, are a joy to look at; where all are beautiful and well-selected, it is almost invidious to mention any in particular, but perhaps *Magnolia sinensis*; *Pyrus* (*Sorbus*) *munda* var. *subarachnoidea* with its white fruits showing beautifully against a dark background; *Halesia monticola* with its bell-shaped flowers; and the charming habit photograph of *Cercidiphyllum japonicum* at Westonbirt, are worth especial mention.

*Magnolia sinensis* Stapf, from West Szechuen, China, where it occurs at 7,500–9,000 ft. altitude, is said to be perfectly hardy, forming a pleasant addition to the list of magnolias. It is described as a deciduous shrub or small tree, bearing saucer-shaped, fragrant white flowers 3–4 inches across, having rosy-crimson stamens; a useful feature is said to be its ability to thrive in a chalky soil. *Meliosma beaniana* Rehder and Wilson, from Hupeh and Szechuen, is said to grow "healthily" at Kew. Wilson described it as one of the most striking and handsome of Chinese trees, with leaves 6–12 inches long, and creamy-white panicles up to 8 inches long and 4 inches wide.

Of *Cornus kousa* var. *chinensis* Osborn, Mr. Bean says that this beautiful flowering tree should be in every garden, being perfectly hardy and blossoming at a season when most hardy trees and shrubs are out of flower. It is encouraging to read of a *Paulownia* (*P. fargesii* Franchet) which seems to be hardier at Kew than is *P. imperialis*.

*Ceanothus cyaneus* Eastwood, is described by Miss Eastwood, the veteran curator of the California Academy of Sciences herbarium, in Golden

Gate Park, San Francisco, as "certainly the loveliest of all the species of Ceanothus, with its large sprays" of flowers of a lovely bright blue, each about ¼ in. across. It is grown at Kew on a wall facing east, but suffered from frost in the spring of 1932, and Mr. Bean thinks it will probably be seen at its best nearer the south coast.

Of other genera represented in gardens by well-known species, many novelties are described, including 29 of *Berberis*, of which 3 are figured; *Betula* 7; *Buddleia* 11, *Ceanothus* 7, *Pyrus* 26, *Prunus* 16 and *Pittosporum* 11.

Of the New Zealand genus *Olearia* (daisy bush), of which the hardy *O. haastii* is the best known, twenty-four species are described, most of which, unfortunately, are hardy only in the mildest parts of Britain.

The genus *Rhododendron* comes in, of course, for the greatest attention, the account of it occupying 91 pages (out of the total 517), 173 species or hybrids being described and 14 figured.

The value of the book is indicated by the fact that a second edition has just been published.

# Mathematics and Agriculture

**Mathematical Treatment of the Results of Agricultural and other Experiments**

By Prof. Dr. M. J. Van Uven. Pp. vi+310. (Groningen and Batavia: P. Noordhoff, N.V., 1935.) 9.50 f.

WE have become accustomed in Great Britain, mainly through the writings of Prof. R. A. Fisher, to the idea that accurate field experimentation in agriculture and cognate sciences is only possible through bringing certain principles of experimental design, mainly mathematical in character, to bear on the problem before the experiment is carried out, and then building up an arithmetical technique, based on the theory of statistics, for the working out of the data resulting from the experiment.

Dr. M. J. Van Uven, who is professor of mathematics in the Agricultural University of Wageningen, Holland, has been associated for many years with agricultural experimentation, and in this book he is concerned to place before readers a careful exposition of the mathematical and technical methods which are needed. He is not writing for the worker who merely desires a formula for the working out of a mean or a standard error. On the other hand, he wishes to be understood by a reader with only a modest equipment of mathematical knowledge. The result is a book, the first half of which is a carefully written and particularly full treatise on least squares. No appeal is made to other than straightforward algebra, but even so the book is by no means easy reading. The general subject is the adjustment of observations, direct and indirect, in one or more variables, including the choice of the representative value, the calculation of mean error of single observations, and of functions of these, and an elementary exposition of probability.

In the second part the author takes up the study of field experiments, beginning by showing how yields of plots can be adjusted when there is a regular fertility distribution. When this condition is not satisfied, he shows how to separate out the systematic and accidental causes of variation by means of an analysis of the variance of the yields. He considers the case of two treatments on alternate plots, and describes his method of working out the standard error of the difference between the treatment means. He recognizes, however, that such an arrangement is far from ideal, and proposes instead that the original plots should be divided to accommodate the number of treatments it is desired to test. This makes the trial one of a larger number of plots of smaller dimensions, but the author does not say how the treatments should be arranged within the plot, whether at random or systematically.

A long description follows of Fisher's methods of block trials, including as a special case the Latin square. There is much to interest the reader here in the exposition of the algebra of the method, and its various ramifications, but the author does not point out that one of the essential features of the methods is the random arrangement. Indeed his examples are systematically arranged, although he does point out, in the case of the Latin square, that some re-arrangement would be advisable to prevent the same treatment occurring down the diagonal.

The author returns to least squares in the last chapter, dealing with the adjustment of direct conditioned observations, and four appendixes are added dealing in detail with points arising in the text. The last, indeed, gives the complete technique of solution for normal equations.

The book is well and attractively printed, and there are few misprints. J. WISHART.

**The Atom**

By Prof. E. N. da C. Andrade. New edition, entirely revised, extended and reset. Pp. ix+129. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1936.) 1*s*. 6*d*. net.

PROF. ANDRADE dedicates this little book to two friends as a memorial to "a lively, learned, and humane luncheon table", and thereby sets the tone of what follows. Starting with an account of the meaning of the atomic theory, he takes the reader smoothly along, with many a well-chosen analogy and an occasional jest, dealing with the atom of electricity, the nature of light, the structure of the atom, the mechanism of radiation and, in the concluding chapter, with the relation between matter and energy.

We read of the positron, neutron, wave mechanics, quantum theory of spectra, transmutation of atoms and artificial radioactivity, all in a descriptive narrative using everyday illustrations to make difficult conceptions clear. A large ship, with engines stopped, rolling and pitching on the open sea, reveals by its motion to an observer in an aeroplane that the sea is rough even though he cannot see the waves; so the Brownian movement in a liquid reveals the motion of its molecules. Cigarettes of various sizes are sold, but we have to buy a whole number; similarly, the quantum of radiant energy varies with frequency, but we never find less than one quantum, whatever the frequency. A given kind of atom may be regarded as singing two characteristic songs in the bass (flame and spark spectra) and one in the high soprano (X-ray spectrum).

Prof. Andrade's hope that he will arouse a desire to pursue the subject further will surely be fulfilled. We may commend the book also to senior physics pupils in schools, who will obtain from it a broad and often novel view of recent developments in their subject.

**The Identification of Trees and Shrubs:**

how to name without previous Knowledge of Botany any Wild or Garden Tree or Shrub likely to be met with in the British Isles. By F. K. Makins. Pp. vii+326. (London: J. M. Dent and Sons, Ltd., 1936.) 15*s*. net.

THE appearance of a book that aims at supplying the means of identification of trees and shrubs that occur in Britain—wild or cultivated out of doors—should meet with a wide appeal. It is true that the indigenous woody species, which number only a few dozen, may be readily named from existing floras and handbooks, and that there are excellent works describing the legion of trees and shrubs now in cultivation; nevertheless, so far, there has been no attempt to provide a general key or other ready means of identification of the cultivated species, and the present work is a pioneer in this respect.

The book is easy of reference and assumes no previous botanical knowledge. Only those species that the author considers most likely to be met with are considered, rare or little-known plants being purposely omitted. In spite of this limitation, the number of woody plants dealt with is 1,732, or rather more than half those listed in the Kew "Handlist of Trees and Shrubs" (1934) which places the total number at about 3,000. Each species is represented by a small illustration or diagram, and is briefly described in the later part of the volume. A preliminary key on basic leaf characters serves to direct the user to the requisite group of diagrams to which any particular plant may belong.

The work should prove useful, particularly in naming the more generally cultivated trees and shrubs; but limitations of size must effect its usefulness in the case of the larger genera with numerous closely allied species, for example, *Rhododendron, Cotoneaster, Crataegus* and certain *Coniferae*.

**Insect Pests of Glasshouse Crops**

By Dr. Herbert W. Miles and Mary Miles. Edited by H. C. Long. Pp. 174+21 plates. (Surbiton: H. C. Long, The Birkins, Orchard Road, Hook, 1935.) 8*s*. 6*d*. net.

GLASS-HOUSE cultivation provides a type of environment which favours the spread and multiplication of a variety of insects and related creatures of injurious propensities. At the same time, these conditions afford facilities for pest control that are often exceptional. The growing extension of the glass-house industry has brought the cultivator up against the problem of pest elimination more realistically than in years gone by. New pests have come to light, species formerly regarded as innocuous have, after proper study, proved to be the reverse, and the list of known invaders has assumed considerable proportions.

Much valuable information is now available on the subject of glass-house pests, but it has mostly remained inaccessible to the amateur and to many professional growers. Dr. and Mrs. Miles have thus supplied a much-needed requirement in the book under notice. Their experience and qualifications have well fitted them for their task and they have produced a sound, up-to-date manual covering the whole range of pests likely to be met with. These are clearly described, along with their life-histories, and the most practical and efficacious methods of control. The book is well illustrated with a remarkably good series of clear photographs, almost all being hitherto unpublished. It can be recommended to all interested as one which is based upon practical experience and not merely compiled from the writings of others.

A. D. I.

**Odyssey of the Islands**

By Carl N. Taylor. Pp. xiv+284+31 plates. (New York and London: Charles Scribner's Sons, 1936.) 12*s*. 6*d*.

MR. TAYLOR describes himself as a 'vagabond', and entertaining as this record of a vagabond's wanderings may be, it does not call for extended notice here. It is, however, to be noted as giving a view of life among the wilder peoples of the Philippines, which includes an account of the too little known and often unapproachable pygmies. The book is illustrated by some excellent photographs.

# The Total Solar Eclipse of June 19, 1936

## Observations at Omsk

By Prof. J. A. Carroll, University of Aberdeen

THE expedition of the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies, and the University of Aberdeen, which was stationed at Omsk, had the good fortune to observe the total solar eclipse of June 19, 1936, under excellent conditions.

The expedition consisted of five members, namely, Prof. J. A. Carroll, professor of natural philosophy in the University of Aberdeen (leader); Mr. E. G. Williams, Solar Physics Observatory, Cambridge; Miss F. M. MacBain, Natural Philosophy Department, Aberdeen; and two volunteer observers, Mr. W. M. Alexander, Aberdeen; and Capt. S. I. Luck, London.

Our programme contained only three principal items, but as the instruments, methods and auxiliary equipment were in many respects quite novel, some detail of description will be of interest to readers of NATURE.

To deal first with the observing instruments themselves, and the results yielded by them:

(1) A very rapid objective prism spectrograph specially intended for exploratory work in the infra-red region of the coronal spectrum, but, of course, also used on the flash spectrum. Five 60° prisms were followed by an objective of two inches aperture and twenty inches focal length, giving a dispersion of about 100 A. per mm. at 9000 A., and covering the range from the *D*-lines of sodium to about 11,000 A. on several pieces of plate of different types. The plates used were (1) Ilford S.R. Panchromatic, (2) Agfa 800 Contrasty, (3) Agfa 950.

We were particularly concerned to detect the coronal radiation at about 9600 A. predicted by Rosenthal[1] on the supposition that the major coronal lines are due to excited helium atoms, and also to observe the line at 7896 A. observed by Curtis and Burns[2] in 1925 and recently observed by Lyot[3] at the Pic du Midi without eclipse. Plates sensitive so far in the infra-red have in general poor keeping qualities, and the plates used were sent by air and by special messenger from Berlin as shortly before the eclipse as possible. We are much indebted to Messrs. Agfa for the prompt supply of fresh plates and to the British Embassy in Moscow and the Poulkovo Observatory for their rapid transit to Omsk, where we could keep them on ice. Thus our plates were in good condition, and thanks to the thermostatic control the instrument performed well.

FIG. 1. Exterior of the cœlostat and experimental hut, looking east. The double-walled hut on wheels for sheltering the cœlostat is on the left. The larger hut is the double-walled, felt-lined hut for thermostatic sheltering of the instruments. At the nearest corner of the large hut can be seen the compressor for the refrigerator plant, and just above it the circular window to admit the horizontal beam from the cœlostat.

The plates show many flash lines and a number of coronal rings. Four exposures were given, (1) 5 sec. on the first flash, (2) 20 sec. on the corona, (3) 90 sec. on the corona, (4) 7 sec. on the second flash. Timing was good, and both flashes are satisfactory. In the flash spectrum, the Ca II triplet at 8500 A. is strong, the usual features show in the visible region and there are several strong lines in the region 9000 A.–10,000 A. not yet certainly identified, probably including a line due to helium. On the coronal exposures 6374 A. is strong and also the line near 7890 A. There is no strong radiation in the expected region near 9600 A., though later examination may reveal traces. The plates were good enough to show strong lines down to 10,000 A. It is interesting to note that at mid-totality prominences show, in $H\alpha$ and the *D*-lines, on both sides of the solar disk.

(2) An objective interferometer of 13 cm. aperture and 105 cm. focal length for the study

of the corona in its own monochromatic green radiation at 5303 A. The aim of this instrument is not, as some seem to have thought, to obtain accurate wave-lengths of the coronal green line. As this line is about 1 A. wide, the use of an interferometer for such a purpose is futile. The point is that by introducing a Fabry-Perot étalon into the optical train of a suitable objective spectrograph, one obtains a spectrograph working in all directions simultaneously as it were, and can obtain at all points of the corona the sort of information given by a powerful prism instrument, with a slit, over a small region only. Thus the variation in wave-length, strength, profile, and

FIG. 2. Interior of experimental hut, showing echelon spectrograph, interferometer and infra-red objective prism spectrograph, with roof and sides of inner thermostatic chamber removed. One of the cooling coils of the refrigerator plant can be seen just above and to the left of the window admitting light from the cœlostat. In the opposite corner is one of the fans of the heating elements. In the centre of the ceiling are two thermostats controlling the cooling and heating elements for hut temperature. In the foreground is the heater element (surmounted by the Expedition's mascot) for fine control of instrument temperatures.

width of the line selected may be observed, and rotation and internal motion of the coronal material measured.

Two 6-inch 45° prisms dispersed the continuous spectrum sufficiently to allow the green ring to show by contrast, and the Ilford Astra VI plates were used, as these have a narrow maximum of sensitivity at 5300 A. with good resolving power and contrast. The plates of the étalon were separated by 1 mm. and were coated with aluminium *in vacuo* in an apparatus specially constructed in the Natural Philosophy Department at Aberdeen, so that the coating was uniform to a fraction of one per cent and the density could be exactly controlled. Thus the greatest resolving power obtainable for the loss of light allowance was secured.

The objective was a triplet of 6-inches aperture specially computed and made by Messrs. Adam Hilger, Ltd. The instrument worked excellently, and comparison fringes obtained during eclipse show exquisite definition at the full aperture.

Most unhappily, the light from the sun was cut off from this instrument during the total phase by a trivial accident, and only the comparison fringes remain to show the excellence of its performance. These are, however, not without interest in view of the remarks later on the need for, and benefits of, thermostatic control of eclipse instruments.

(3) An echelon spectrograph with automatic camera giving successive exposures of about 1·5 seconds for the study of the flash spectrum. It is of great interest to obtain accurate measures of the shapes of the chromospheric emission lines and of the changes in their shapes with height in the chromosphere. As these lines are only some 0·5 A. or so in width, very high resolution and dispersion are needed. An echelon spectroscope, crossed by, say, a pair of prisms, is almost the only instrument satisfying the necessary conditions for this type of observation, but so delicate an instrument is hard to use under eclipse conditions, and further, no echelons of large aperture exist.

The Natural Philosophy Department at Aberdeen possesses a very fine transmission echelon of 33 plates, each 1 cm. thick, height of step 1·1 mm., width 37 mm. This is still a very small aperture, but in view of the great interest of the observations and the great expense of a larger echelon, it was decided to attempt the observation of the flash spectrum with this instrument despite its small aperture. The information obtained would in any event be of vital importance in showing the practicability of the method and the size of instrument needed for accurate measurements, even if the flash spectrum turned out to be under-exposed.

As ordinarily used in air, the instrument had too small a separation between successive orders for use on the chromospheric lines, and the expedient of using the echelon immersed in oil of suitable refractive index was tried. Fortunately, the plates of the echelon turned out to be sufficiently homogeneous to permit this, and the main

difficulty was due to the now abnormal sensitivity of the instrument to temperature changes. Liquids all have a temperature coefficient of refractive index some ten or more times that of glass, and to maintain homogeneity to a small fraction of a wave-length in a column of liquid 40 cm. long by some 8 cm. square proved a formidable task. Success was ultimately attained by careful thermostatic control, combined with the use of concentric thick-walled chambers of good conducting material (brass or copper) separated by air spaces or lagging, so that the echelon and its oil were surrounded by three such 'tunnels', and uniformity of temperature was satisfactorily obtained. The optical and mechanical details of the instrument are far too elaborate to describe in a short article. In essence, the appropriate portion of the chromospheric arc is picked out by a specially designed image rotator and achromatic collimator, and the light dispersed horizontally by two flint prisms and vertically by the echelon. The resulting spectrum is received on a film in a camera automatically operated to expose for about 1·5 sec., then move the film forward in about 0·2 sec. and expose again as often as desired.

The spectra obtained at eclipse proved too faint for useful measurement of flash lines, but the spectrum of the disappearing limb of the sun is well exposed for a study of darkening towards the limb in the last minute of arc over the region 4000–5000 A. It is of interest to note that the Fraunhofer lines seem to have almost completely disappeared by 10 seconds before second contact. The results given by this instrument suggest several possible avenues for exploration at future eclipses, and give accurate data enabling the design of a larger instrument to be undertaken with confidence in its adequacy and practicability.

Perhaps the most interesting and striking feature of our programme was the temperature control of the apparatus.

Modern eclipse observing requires the utmost of the optical performance of the instruments, and it is quite idle to set up spectrographs of any size with prisms and lenses, etc., figured to the last fraction of a wave-length, and expect any but mediocre results if they are subject to the ambient diurnal temperature changes. Still more is this so if interferometric apparatus is used. In Omsk the diurnal range of temperature was some 11° C., and this fluctuation was about a mean temperature that varied every few days from about 10° C. to 25° C. Ordinary lagging and screening by temporary shelters is hopelessly inadequate to deal with this, and it was decided to attempt complete and accurate temperature control as practised in the laboratory.

For this purpose the cœlostat mirror was of pyrex glass, and instead of the usual temporary canvas shelter a well-ventilated double-walled wooden hut, on wheels, was used to prevent undue fluctuation of mirror temperature. The performance of the mirror showed these precautions to be adequate so far as the cœlostat mirror is concerned, though a fused quartz mirror would be worth while. As the cœlostat must necessarily be uncovered in use, more accurate thermostatic control of it is impracticable.

The spectrographs themselves were very elaborately housed and controlled. Steady thermal conditions were obtained in two stages. First of all, a coarse control of the interior of the experi-

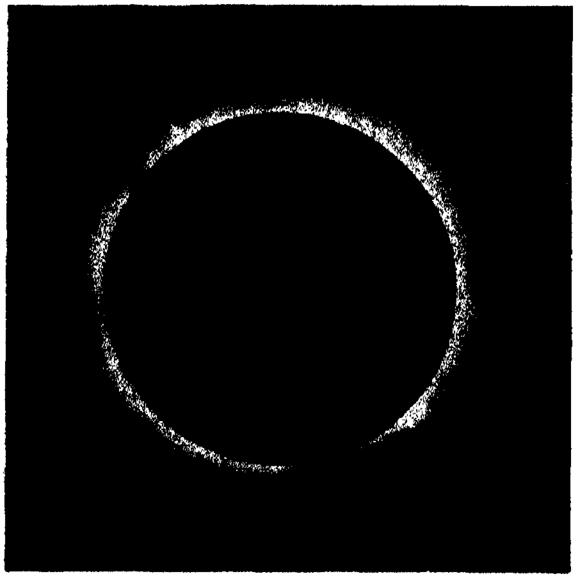

FIG. 3. Photograph of the corona taken by Mrs. Balanovsky, of Poulkovo Observatory, at Omsk. Lens, 5 m. focus; 10 cm. aperture; exposure, 1 sec. on Ilford Special Lantern Plate. By courtesy of Prof. B. P. Gerasimovic, director of Poulkovo Observatory.

mental hut. This hut was of wood, double-walled and felt-lined, with canvas screens (kindly supplied by the Willesden Paper & Canvas Works, Ltd.) for roof and walls. The mean temperature inside was maintained at about 15° ± 1° C. by means of a 1½ h.p. compressor and refrigerating coils (air conditioning units) lent by International Refrigerators, Ltd., and also by two 1 kw. low-temperature heating frames interlocked with the refrigeration control and regulated by a thermionic relay. Within the hut the instruments themselves, supported on masonry piers, were further enclosed in a lagged wooden chamber maintained at 1° C. ± 0·01 above mean hut temperature by thermostat and thermionic relay operating a low-temperature heater only. Tests of heat transfer in Aberdeen showed this system to be practicable and able to deal with the variation of external conditions expected in Omsk.

It is very gratifying to be able to report that the installation, despite its elaboration, worked excellently. Some sixteen separately wired and fused circuits drawing currents of from ½ ampere to 20 amperes were needed and were required to operate smoothly for a fortnight or more before the eclipse ! Some troubles avoidable on a future occasion were experienced, but nothing disastrous, and the vagaries of electrical supply usual in remote districts were nobly reduced by the Omsk Electrical Supply Authorities despite our being some 8 km. from the generating station, on a line supplying heavy loads *en route*. Without the willing co-operation and special provisions of the supply authorities our efforts would have been nullified, and the way in which this unusual demand was met was typical of the treatment our Expedition received in the U.S.S.R.

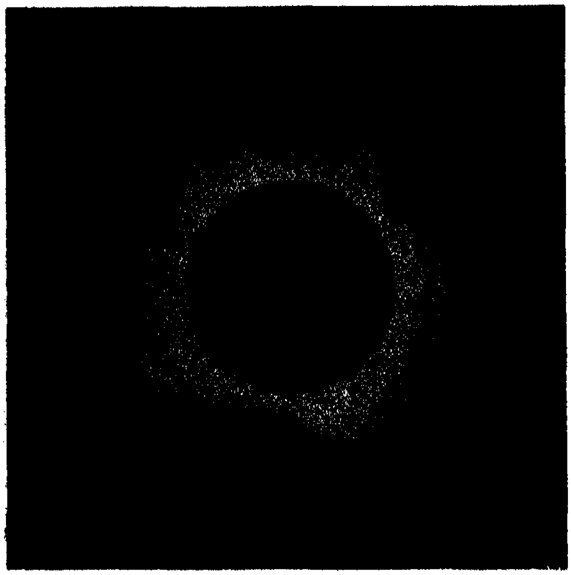

FIG. 4. Photograph of the corona in ultra-violet light taken by Dr. G. Tikoff, of Poulkovo Observatory, at Sara. Lens, 1·5 m. focus ; 8 cm. aperture ; exposure, 36 sec. on Ilford Special Rapid Plate. By courtesy of Prof. B. P. Gerasimovic, director of Poulkovo Observatory.

It would have been idle to take such elaborate precautions to ensure perfection of optical performance if the photographic materials had not been equally carefully prepared, tested and selected. The resolving power of many suitable emulsions, as well as their sensitivity, was carefully measured in Aberdeen, and the equipment so designed that the optical resolution attainable could be fully utilized. We are much indebted to the Research Department of Messrs. Ilford, Ltd., for the willing preparation of special materials and samples for this work and to Mr. Olaf Bloch for much time spent in valuable discussion.

One point of anxiety that was difficult to relieve by tests made in advance was the question of the correct temperature of stabilization for the instruments. Any desired temperature could be maintained, but clearly the desideratum is to have the instruments as near as possible to the actual temperature of the outside air at mid-totality. The expected temperature, based on mean diurnal records and calculations of temperature drop during the partial phase, was 15·5° C. The eclipse day itself was cooler than average, and the actual temperature was only 13·5° C. at mid-totality. The light was admitted to the instruments through a hole in one end of the hut, and a corresponding hole in the interior casing. These apertures were fully opened some five minutes before second contact and all temperature controls disconnected, the aperture into the hut being opened and the coarse controls suspended some 15 minutes earlier. The definition during totality proved excellent and the trouble feared from air currents did not arise.

The general 'seeing' was very good, and as the down-coming beam from the sun had to pass over the roof of the hut, this was covered for the greater part of the partial phase by a Willesden canvas sheet, removed shortly before totality and leaving the roof itself in good temperature equality with the surrounding air.

It is with great pleasure and gratitude that we can say in conclusion that no praise is too high for the arrangements made for us and facilities given for ourselves and our apparatus. On all sides we met with cordial co-operation, and a willingness to cut through routine procedure to expedite or to simplify our task. The special committee appointed by the All Union Academy of Sciences made excellent arrangements, which were well carried out, and the Government of the U.S.S.R. granted us exceptionally favourable rates for transport and housing, so that it was possible to take out sufficient equipment and personnel to execute this elaborate programme in the middle of Siberia. To Dr. B. P. Gerasimovic, director of Poulkovo Observatory, in particular, we are especially indebted for his personal attention to the hundred and one points of detail, as well as for the major planning of the arrangements made for us in the U.S.S.R. By his courtesy, two excellent photographs (Figs. 3 and 4) of the corona obtained by the Poulkovo expeditions at Omsk and at Sara are reproduced here. The main Poulkovo station was near us at Omsk, on State Farm No. 54, and its observers and the staff of the State Farm rendered us much assistance for which we are deeply grateful.

[1] A. H. Rosenthal, *Z. Ast.*, 1, 115 (1930).

[2] Curtis and Burns, *Pub. Alleg. Obs.*, 6, 95.

[3] B. Lyot, *C.R.*, 202, 1259 (1936). Lyot gives 7891·6 ± 0·2A. as a new line. The observations of Curtis and Burns in 1925 do not seem to be recorded in any of the more recent lists of coronal lines. I assume provisionally their line at 7896 is the same as Lyot's, allowing for the relative inaccuracies of the measurements made in 1925.

# The Formosa Earthquake of April 21, 1935

WITHIN a year after its occurrence, the reports on this destructive earthquake have been issued in a special volume (Supplementary volume 3, 238 pages) of the *Bulletin of the Earthquake Research Institute*. The memoirs (eleven in number) are written in Japanese, each being followed by a summary in English. The five reports are also in Japanese, but only one of them contains an outline in a Western language. Few works on any earthquake have been so admirably illustrated, for half the volume consists of 29 maps and 119 plates, each of the latter containing reproductions of two or three photographs, with titles in English as well as in Japanese. They represent the damage to villages and buildings, the buckling of railway lines, the fissures in roads and fields, and various aspects of the remarkable earthquake faults.

The recent seismic activity of the northern half of the island is described by Prof. N. Miyabe (pp. 1–9), who notes that, since the beginning of 1934, the frequency of minor shocks felt at Ari-san (near the centre of the island) showed a continual increase up to the time of the great earthquake at 7.2 a.m. on April 21 (April 20, 10.2 p.m., G.M.T.). From seismographic records, the epicentre was found to be in lat. 24° 20′ N., long. 120° 38′ E., and the depth of its focus about 10 km. below the land-surface. The earthquake was very destructive to life and property; 3,279 persons were killed and 54,792 houses destroyed. In seven villages in the Taityu district, more than 70 per cent of the houses were ruined, but, as several of the authors notice, this was mainly due to their poor construction, the walls being formed of *dokaku* or blocks of hardened clay and straw, and very much weaker than those of the wooden houses in Japan. Mr. R. Takahasi (pp. 120–140) notes that the greatest intensity of the earthquake was reached in two regions that coincide with the north and south branches of the earthquake faults.

According to Mr. Y. Otuka (pp. 22–74), there were two main faults along which displacement of the crust occurred. The northern or Siko fault is about 15 km. long and runs in a direction about N. 30° E. from Gabi-syô to Taitôsei. Along this fault, the west side rose in two places about 3 metres relatively to the other side, the horizontal displacement being quite insignificant. The southern or Tonsikyaku fault is about 12 km. long and its general trend about N. 60° E. The north-west side of this fault was, relatively to the other side, shifted 1–1½ metres to the north east. Shortly before the earthquake, a fault was traced running from Gabi-syô to Taian, and the earthquake faults lie close to and parallel to this line. Mr. Otuka records the interesting fact that, at two places, the fault-movement took place after the houses in which the observers lived were destroyed.

From August until December 1935, the after-shocks were recorded at a network of four stations at which Ishimoto acceleration seismographs were installed. Most of the epicentres, according to Mr. N. Nasu (pp. 75–86), lay on the west side of the faults, and the focal depths were usually about 10 km. or less. In many of the shallow-focus earthquakes (depth 0–5 km.), the epicentres were close to the fault, especially in the upheaved region on its west side. Mr. Nasu notices that this was also the case with the after-shocks of the Tango earthquake of 1927 that he studied with so much care. At Byôritu (Taiwan), where the after-shocks were frequent, the level of the water in a well was measured from October 1935 (N. Miyabe and S. Kawasima, pp. 93–95). On the curve representing the changes of level from October 30 until January 10, dots are placed corresponding to the times of the after-shocks, and these occur at every point at which the level varies in direction.

The buckling of railway lines during a great earthquake is due, as a rule, to subsidence of the ground or to the destruction of the embankments on which the rails are laid. Such buckling occurs in both horizontal and vertical directions. Mr. R. Takahasi (pp. 148–153) describes and illustrates several cases of sinuous buckling. These are confined to a horizontal plane and lie along the fault-zone or its continuation. The buckling thus seems to be due to the movement of the surface layer of the ground on one or both sides of the fault.

Immediately after the earthquake, repetitions of first order triangulation and first order levelling were carried out in the central area by the Japanese Land Survey. The former, begun in August and finished in December 1935, included 14 points, three of which by comparison with the previous survey in 1917 had shifted by 26, 33 and 44 cm. The levelling was repeated along a route, 270 km. in length, from Kiirun and Musya, and was begun in October 1935 and completed in the following March. In the interval since the preceding survey, it appears that one point rose 23 cm., while another subsided 68 cm.

C. D.

# Obituary

## Sir Arnold Theiler, K.C.M.G.

THE death of Sir Arnold Theiler on July 24 at the age of sixty-nine years has removed from our midst one of the greatest and most practical exponents of veterinary science of the century. There was no man more cosmopolitan in his principles, nor indeed was there a veterinary surgeon who was more universally welcomed in every country within whose borders he set foot, than Sir Arnold. His modest demeanour and his forceful personality, together with his untiring patience and plodding disposition, made him welcome everywhere. A Swiss by nationality and a veterinary graduate of the University of Berne, Great Britain was lucky in having him as a worker within its Colonial domains; and it was a great day for the British veterinary profession when Sir Arnold was offered—and accepted—the honorary associateship of the Royal College of Veterinary Surgeons. It was also a great honour for the Royal Veterinary College in London, when Sir Arnold made the request to Sir Frederick Hobday, its principal, that he might complete, within its walls, the summary of the great work which he had collected together on the osteo-dystrophic diseases of bone. This shortly followed his lectures (which were also given in the Royal Veterinary College, at the request of the University of London), and it was another fortunate circumstance that the editor of the *English Veterinary Journal* was able to secure the publication of these lectures in his journal.

Born in Switzerland in 1867, Theiler went to the Transvaal as a doctor of veterinary medicine in 1891. He found the Boer farmers very difficult; their narrow ideas, which led them to think that the diseases of their cattle and sheep were punishment inflicted upon them by the Almighty, were very difficult to overcome. It was only when a severe outbreak of glanders among the horses in Pretoria, and a disastrous outbreak of rinderpest in their cattle, enabled him to demonstrate the value of scientific veterinary knowledge in checking these respective outbreaks, that his consummate patience and skill triumphed to the extent that President Kruger, realizing the great value of Theiler's help, appointed him Veterinary Surgeon to the Republic. The South African War temporarily checked his work, and, as a burgher, Theiler was appointed veterinary surgeon to the Stäats Artillery, a position which he filled with credit to himself—all the time with his brain working and learning points which stood him in good stead afterwards in his combat against disease.

Returning to Pretoria after the War, Theiler's reputation made him *persona grata* with the British Army staff, who were quick to recognize his knowledge and ability; and he was given laboratory facilities at Dasspoort and provided with an adequate staff. Whilst there, he came in contact with Lord Milner and Mr. F. B. Smith, the Director of Agriculture; and eventually he was given practically a free hand, the result being the foundation of the greatest experimental veterinary laboratory in the world—at Onderstepoort. The Botha and Smuts Government gave him staunch support and, on the formation of the Union in 1910, Arnold Theiler became the first Director of Veterinary Research. In 1920 he organized the Veterinary Faculty of the University of South Africa, being appointed its first dean, a post which he held until his retirement in 1927.

Theiler's honours were many. In 1907 he had been created a C.M.G., and in 1914 the knighthood of this order became his; then the fellowship of the Royal Society of South Africa and the first grant and medal awarded by the South African Association for the Advancement of Science. He was also the first recipient of the Scott Medal of the South African Biological Society. He was an honorary D.Sc. of the Universities of Cape Town and Syracuse, and D.Phil. of the University of Berne.

Theiler's married life—always very simple—was a happy one, and he leaves behind a widow, two sons and two daughters, all of whom are making names for themselves in the world of science. His death has left a gap which it will be very difficult to fill; but his name will ever remain not only as a pioneer, but also as a creator, in the world of veterinary science.

## Dr. Bernard Smith, F.R.S.

BRITISH geology in general and the Geological Survey of Great Britain in particular have suffered a lamentable loss through the death on August 19 of Dr. Bernard Smith. Since October of last year he had served as director of the Geological Survey and Museum in succession to Sir John Flett. Smith was not only a brilliant geologist but also a scientific worker of exceptionally wide outlook, and, as he had served for thirty years on the Geological Survey in varied districts and capacities, his knowledge of the geology of Great Britain was most accurate and extensive. He had a very lovable personality, being genial and sympathetic by nature, and his sound judgment carried him successfully through many difficult situations. He died at the comparatively early age of fifty-five years, while it might have been anticipated that he had at least ten years of active work to look forward to in the Government service. Up to a few weeks ago, he was in regular attendance at his office.

Smith was born in Grantham and had his preliminary education at King Edward VI School there. He passed to Sydney Sussex College, Cambridge, as a scholar, and graduated in the first class of the Natural Science Tripos, Parts I and II. He won the

Harkness Scholarship in 1906, having been a demonstrator in geology since 1904, and in 1906 also he entered the Geological Survey by competitive examination. For a time he worked in the Midland coalfields districts under Lamplugh, but he surveyed also in North Wales. When the Great War broke out he devoted much time to the study of British iron ores, on which subject he ultimately became a recognized authority; but he also gave much assistance to the Ministry of Munitions on many other subjects connected with British resources of economic minerals.

In 1920 Smith was appointed district geologist, and shortly thereafter proceeded to Whitehaven where he superintended the revision of the geological maps of the Cumberland coalfield and adjacent districts. He had already produced a notable monograph on the Cumberland hæmatite iron ores which soon passed into a second and revised edition, and is the standard work on that subject. The Cumberland coalfield is very complex in structure and was not well understood before the revision undertaken by Bernard Smith and his staff; but it may be said that it is now one of the best known British coalfields, and the new maps and memoirs leave nothing to be desired. His work in that district was much appreciated by the local engineers and mine owners, and his personal relations with all connected with the industry, even though they might differ from him in opinion, were always excellent.

In 1931 Dr. Smith succeeded Mr. John Allen Howe as assistant to the Director in London and was placed in charge of all the field work in England. He also arranged the North Wales exhibits in the new Museum of Practical Geology. His time was now principally occupied in administrative work, and in answering inquiries sent in by Government departments and by the public. In this respect he was a great success, and in due course he succeeded to the directorship of the Survey and Museum in October, 1935.

Smith's natural bent to field geology was shown by his text-book of "Physical Geography" (A. and C. Black, Ltd.) now in its third edition. He also wrote on the glaciation of the Lake District and of the Isle of Man and on the history of Cumbrian rivers. His official work was very varied, but his principal contributions to Survey literature were his "Iron Ores of Cumberland" and the memoirs on the Whitehaven coalfield which he edited and in large part compiled. He was awarded the degree of Sc.D. (Cambridge) in 1924, and the Bigsby Medal of the Geological Society in 1927. The Royal Geological Society of Cornwall conferred on him the Bolitho Medal in 1933. In 1933 he was elected fellow of the Royal Society, and he served on the Council. In 1935 he delivered the Cantor Lectures on "Underground Water Supply" at the Royal Society of Arts; and he was actively engaged in the work of the Inland Water Resources Committee of the Ministry of Health. He served also on the National Committee of the Union of Geodetics and Geophysics and was a member of the Sub-Committee on Vulcanology and Hydrology.

## Dr. H. A. D. Jowett

IN a characteristic appreciation of the late Sir Henry Wellcome, published in *The Times* of August 3, Prof. H. E. Armstrong points out that he chose his men with great shrewdness. It is with great regret that we have to record, so soon after the loss of Sir Henry Wellcome himself, the death of one of these chosen helpers, as the result of a motor accident on Monday, August 10. Dr. Jowett was born at Dorchester in 1870, but received his education at the Royal Grammar School, Lancaster, and remained in that town until 1891, when he gained a Bell Scholarship offered annually by the Pharmaceutical Society and became a student in the Society's College in Bloomsbury Square. He took his diploma in due time, along with most of the College prizes, and was awarded the Redwood Scholarship, which gave him entry to the Society's Research Laboratories, where he remained until 1896, working on aconitine and atisine, the latter being the subject of the thesis which he presented successfully for the London D.Sc.

In that year, Jowett became chief assistant in the newly-founded Wellcome Chemical Research Laboratories. There he spent ten busy and fruitful years, during which he made contributions of the first importance to our knowledge of the chemistry of the alkaloid pilocarpine, the hormone adrenaline and some of the naturally occurring glycosides and anthraquinone derivatives, chrysophanic acid, emodin and aloin. The work on pilocarpine and adrenaline was not only important in itself, but also it stimulated interest in the glyoxaline nucleus and in pressor amines, subjects which were to occupy both chemists and pharmacologists in the Wellcome Laboratories for some years to come. Jowett also began during this period those interesting investigations on the effect of change in structure in the tropeines on their mydriatic action.

In 1906 Jowett left London for Dartford to inaugurate the Experimental Department of the Wellcome Chemical Works, and a year later was appointed works manager, but was still able for some years to continue with collaborators the researches started in London. Having acquired a considerable reputation as an investigator, Jowett must have accepted his new post with some misgivings, but he soon justified his choice, and under his management the manufacture of fine pharmaceutical chemicals increased slowly but surely, and when War broke out in 1914 the works were ready to take a great part in the manufacture of those essential synthetic drugs which the nation had up to that time been content to import. In a very short time British equivalents for such complex drugs as 'salvarsan' and 'neosalvarsan' were being manufactured, and numerous other fine chemicals were added as required.

This development has continued steadily to the present time, and in this connexion it is only necessary to refer to the rapidity with which the manufacture of new products, such as insulin, ephedrine and ergometrine, has been undertaken and to the successful research work on cardiac glucosides and ergot

alkaloids now in progress in the experimental laboratories at Dartford, to show that his inspiring personality was as vigorous as ever after forty years service to the Wellcome Foundation.

Dr. Jowett was not only skilled in chemistry, administration and the management of men: he became a motorist almost as soon as motor-cars were available; he was a keen golfer and an enthusiastic Wagnerian, and in recent years he developed a great interest in local government, becoming a member of the Dartford Borough Council, where as chairman of the Health Committee his administrative experience and scientific knowledge were of great service to his fellow citizens.

Dr. Jowett's friends are not likely to forget his achievements, but they will remember even more vividly his kindly and lovable personality.

WE regret to announce the following deaths:

Prof. F. Breinl, professor of hygiene in the German University of Prague, an authority on bacteriology, on July 29.

Prof. B. G. Cormack, emeritus professor of botany in the Anderson College of Medicine, Glasgow, on August 19, aged seventy years.

Dr. W. G. Plummer, assistant keeper in the Science Division (Physics and Geophysics) of the Science Museum, South Kensington, on August 2, aged thirty-eight years.

W. Rintoul, O.B.E., a director of research of Imperial Chemical Industries, Ltd., formerly manager of the Ardeer factory of Nobel's Explosives Co. Ltd., on August 24, aged sixty-six years.

# News and Views

### Synthesis of Vitamin $B_1$ (Antineurin)

SINCE the realization that the molecule of vitamin $B_1$ contains two heterocyclic rings, a substituted pyrimidine and a substituted thiazole, intensive research has been directed towards establishing the positions of the substituent groups and the method of combination of the two rings. According to a paper of which a brief abstract appears on p. 372 of this issue, Prof. Williams and his collaborators at Columbia University have now succeeded in isolating a compound which is chemically and physiologically identical with the natural vitamin. Several groups of workers in Great Britain and Germany have been working at the same problem, but they will doubtless be among the first to congratulate the American chemists concerned on a brilliant and important piece of organic synthesis. It may be noted that this achievement means that, with the syntheses of ascorbic acid, lactoflavin, vitamin D and vitamin $B_1$, four vitamins have now been produced from completely inactive organic reagents by purely chemical means.

### New Fossil Anthropoid Skull from South Africa

A DISCOVERY is announced from South Africa which, if first impressions are confirmed by more detailed examination, may go far towards clearing up a point which has been a matter of acute anthropological controversy for more than a decade. Dr. Robert Broom, of the Transvaal Museum, and his colleagues, it is reported in a dispatch from the Johannesburg correspondent of *The Times* in the issue of August 26, have discovered in the Sterkfontein caves near Krugersdorp, a natural cast in limestone of the brain of an advanced type of ape and a number of fossilized bones of the skull, including jaws and teeth. It is anticipated that this new evidence will prove of importance in its bearing upon the status of the phylogeny of man and the great apes, and more especially on the position of the Taungs skull. It will be remembered that, when that fossil was found in 1924, some doubt was expressed as to how far the approximation to the human type in its characters stressed by Prof. Raymond Dart, by whom it was discovered, was due to its immaturity. The young of the chimpanzee, it was pointed out, is well known to exhibit pseudo-human characters, which disappear as maturity approaches; and it was agreed that the Taungs skull was that of an individual of not more than six years of age. As the Sterkfontein specimen, it would appear, is adult, a comparison with the Taungs skull may determine these uncertainties, and at the same time afford an indication of the relation of these fossil types to existing anthropoids as well as to early forms of man.

### Roman Leicester—a National Asset

THE fate of Roman Leicester, which now hangs upon the decision of the City Council, is a problem in which the nation is no less deeply concerned, though from a slightly different point of view, than the city itself. A site in the heart of the city's oldest relics, purchased at a cost of £24,000 for the erection of public baths, has yielded on excavation remains of the Roman period, more particularly of the forum, the centre of municipal life, which in certain respects are unique (see NATURE of July 11, p. 69). While on one hand the local authority may allow due weight to the advantage to Leicester in the possession of this unique and irreplaceable monument of the past, yet local pride must inevitably be tempered by a sense of the duty of trustees of public funds; on the other hand the nation at large is a custodian of such treasures as this for the benefit not only of contemporary archæological studies, but also of posterity. The most meticulous records of excavation, however valuable for scientific study, cannot take the place of relics

of antiquity which have been destroyed. Apart from the educational appeal of the buildings in their original relation, and so far as possible, in an appropriate setting, they will afford the scholar a constant inspiration to further research, as well as provide a source of evidence for correcting or reconstructing theory in the light of later knowledge, such as never can be derived from a written record, photograph or drawing. The excavations now in progress may reinforce the argument, or should the City's decision be adverse to preservation, justify a delay, which will then be urged, pending an appeal for funds from outside sources for the complete excavation of the site in the coming year. The conflict between duty to local economies and the preservation of antiquities, which are national in their interest, is one which is likely to arise with increasing frequency in view of the rapid development of urban and suburban properties now taking place. When such developments affect relics of wide historic and scientific interest, as at Leicester, it is a question whether national funds should not be called on to assist.

### Potters of Lincoln

MUCH interest is attached to the discovery of a Roman potter's kiln at Lincoln, fully loaded with a light cream ware, and fired, but unopened. It affords evidence that an industry, which discoveries in 1932 have shown to have been in existence here in the Middle Ages, was also extensively practised in the Roman period. Quite possibly, as 'Pottergate Arch' nearby, and the occurrence of 'Pottergate' as a street name in the thirteenth century would suggest, the industry may have survived throughout the interval between medieval and Roman times with little or no interruption. The kiln was discovered, it is reported in *The Times* of August 21, on a site in Cathedral Street. It contained vessels of the mortaria type, the large shallow basins with a heavy rim, in which the Romans used to grind their food. The kiln was a hole in the ground four feet long and two feet wide, with a well-fired wall on two sides. It was roofed over with a whitish clay mixed with sand; and it contained four stacks of pottery, which had been considerably crushed. Curious short pipes, of which the use is obscure, were also found. Many of the vessels were stamped with the potter's mark, which, when deciphered, should afford a clue to the distribution of Lincoln pottery in Britain. The medieval pottery, which was found in this area, was attributed to the fourteenth century. No doubt the potters of that date drew their clay from the same source as their Roman predecessors. This in itself would be sufficient to account for the persistence of the industry in this area.

### Minoan Influences in Ancient Syria

SIR ARTHUR EVANS, commenting on the results of Sir Leonard Woolley's recent archæological investigations in Syria (see NATURE of July 4, p. 20 and August 8, p. 235), pronounces the Minoan impact on inner Syria at so early a date, for which the ceramic relics from Tell-Atchana afford evidence, as "a new historic fact of far reaching importance and revolutionizing all previous ideas". It is, he points out in *The Times* of August 19, a step forward of at least two centuries; for although there are no actual imports from Minoan Crete, the starting point in repeated examples of pottery reflecting Cretan models must certainly touch 1700 B.C. Sir Arthur bases this conclusion on the chronological datum of remains of cups, of somewhat thin make, showing white rosettes on a black ground, recalling the "egg-shell ware" bowls of the great age of Minoan Crete of the Second Middle Minoan period, which goes back to the eighteenth and nineteenth centuries, but in Syria equating with the succeeding Third Middle Minoan style. At the same time, mixed influence is to be seen in the combination of arcaded zones, characteristically Minoan, with highly conventionalized ducks, which find a parallel in early Palestine, while one of the sherds depicts an uprearing goat charged by another, whereas animal designs were excluded from the vase painting of Cretan Palace art. In concluding with an analysis of motifs, which point to a fusion of Cretan and indigenous religious and symbolic ideas, relating to the cult of the double axe, and reference to tradition of a royal alliance with Cyprus, Sir Arthur holds out the alluring possibility that the spade may yet uncover a royal sepulchre at Tell-Atchana.

### Special Exhibit at Ipswich Museum

IN 1917, Mr. Reid Moir announced the discovery of flint implements, mammalian and human bones, and fragments of rough pottery, in the lower of two superposed 'floors' in a brickfield of Messrs. Bolton & Co. at Ipswich. These occupation levels occurred in sand, and were overlain by a considerable thickness of hill-wash, while the excavations carried out showed that the now dry valley in which the discoveries were made has been deepened by erosion since the floors were occupied by man. Similar results were obtained, at a later date, by Mr. J. P. T. Burchell, in his researches at Ingress Vale in the lower Thames Valley. Here, at the base of an extensive section of sub-aerial loam, surmounted by a hill-wash containing rafts of Coombe Rock, was found a prolific floor, with flint implements, flakes, and fragments of primitive pottery. The third site, where a similar association of relics occurred, was discovered and investigated by Mr. and Mrs. MacAlpine Woods in a dry valley at Bovey Lane, Beer, Devon. In this case, a hill-wash, some 11 ft. in thickness, contained large numbers of flint artefacts, a few examples of bones and teeth of animals, and some pieces of rough pottery. Through the kindness of the discoverers, the Ipswich Museum now possesses representative series of the specimens mentioned, and is making a special exhibition of them. The matter is of considerable interest to archæologists as, in each case, the flint implements may be said to resemble, in their forms, those of Lower and Upper Aurignacian times, and are not associated with any microliths. Moreover, there seems good reason to believe that the widespread deposits in which the relics were embedded

are of relatively considerable antiquity, and represent the results of geological activity, including an epoch of low temperature, in eastern and southern England.

### *Current Science*

WITH the publication of its July issue, our Indian contemporary, *Current Science*, enters upon its fifth year. Founded to supply an obvious need in the scientific renaissance of India, *Current Science* is almost unique in that its editor is assisted by a board comprising the majority of the best-known Indian men of science. The July issue contains much of interest not only to India but also to the West. The leading article comments on the inauguration, by his Excellency the Viceroy, of a Nutrition Advisory Committee. The outstanding investigations of Sir Robert McCarrison in Coonoor have in recent years focused the attention of Indian public opinion upon the importance of adequate feeding for national efficiency. Inadequate nutrition, combined in many areas with endemic malaria, is known to be the cause of the poor physique of many classes. The Royal Society is now assisting in the investigation of the intricate problems of malaria control, and will doubtless co-operate with this new Advisory Committee. Another article in the July issue, of more than local interest, is the summary of a lecture given by Prof. Birbal Sahni on the Karewas of Kashmir, where the geology of the Karewas series in the Himalayas is discussed from the point of view of the botanist. We congratulate the editor of *Current Science* on the high standard of the journal, which, if maintained, ensures its continued success.

### Philosophy and Quantum Theory

IF philosophy is, as Descartes claimed, the 'universal science', it should be able to assimilate all new discoveries in the special sciences. There was not much difficulty in dealing with classical physics. When the theory of relativity was put forward, it was soon found that philosophical ideas could be rearranged to find it a place, and even a welcome, but what is to be the attitude to a theory which denies continuity and determinism ? An attempt, admittedly incomplete, to answer these questions has been made by R. Dugas ("La méthode dans la mécanique des quanta". Actualités scientifiques et industrielles, 283. Paris : Hermann et Cie., 1936). Following Meyerson, complete indeterminism is rejected, and replaced by aggregates ruled by laws of probability. If there is no law, there is no science. Other difficulties arise when we try to discover the basis of Schrödinger's equation. Are we to say that our equations know more than we do, and that, without understanding them, we can rely upon them to furnish the correct results ? Are we to believe in *panmathesis*, and in a universe in which electrons and matter have no real existence, but are merely names for mathematical symbols ? The trouble with questions such as these is that all the available evidence appears to point to the conclusions that are repugnant to common sense.

### Photomicrographic Reproduction of Scientific Papers

FOLLOWING on the formation of the Documentation Division of Science Service, a programme of testing mechanical methods of applying photomicrographic duplication of scientific literature is being developed, including a camera for copying upon 35 mm. film, supplementary apparatus such as a book holder for the camera, film container, etc., a reading machine, microfilm viewer, projection printer, and developing and processing apparatus for 35 mm. microfilm and paper projection points. Procedure has already been developed for the publication of scientific material otherwise unable to receive publication in full. Editors of journals or institutions deposit typescripts of those papers or portions of papers which they are unable to publish promptly or completely. With an abstract or summary, they publish a statement that additional matter, illustrations, tables, etc., are available on request from Science Service if the document number is stated and the price remitted. The document is assigned a number by Science Service and on receipt it is photographed on 35 mm. film master negative. The original document is then deposited elsewhere as a safeguard. The photomicrographic duplication is economical when up to twenty-five copies at a time are required and has the further advantage that the document is continuously in print as the negative can be used to supply a copy on demand at any time.

THE relation of microfilms or photo-copies prepared in this way to priority in scientific discoveries has been raised. Opinion is expressed in a note issued by Science Service that microfilm or photo-copy publication is a printed publication in the true sense, and that by considerably reducing the time between the submission of a paper to a journal and the date of publication of the discovery announced therein, this type of publication will be of great assistance in eliminating controversies such as have arisen in the past concerning individual claims for priority in making discoveries. If any doubt exists as to whether photomicrographic publication is a 'printed publication', it is urged that this doubt could be removed by scientific societies merely agreeing among themselves that, in so far as priority in their fields is concerned, photomicrographic publication should be accorded the same weight and effect as publication in a printed journal.

### Wind Erosion in South Australia

WIND erosion is becoming an increasing danger in the semi-arid regions which form the world's chief granaries. In North America, the Argentine and to a less extent in Russia, the fertile prairie soils are rapidly being swept away as the result of destroying the original grass cover. A similar fate is overtaking vast pastoral regions in South Australia, due to overstocking. The gravity of the situation is revealed in a note by F. N. Ratcliffe, received from the Commonwealth Council for Scientific and Industrial Research. The worst erosion has been in the 'bush' country, where twelve drought years have so

lowered the stocking capacity that overstocking on established farms is now almost unavoidable. Rabbits have added to the evil, the vegetation cannot recover after grazing, and natural regeneration of both shrubs and grasses has virtually ceased. Large areas have become barren deserts, and no measures are available for their reclamation. The evil might be checked by adopting a lower stocking policy; but the only hope for the already denuded areas is to introduce perennial exotic plants capable of stabilizing the large sand drifts, and withstanding rabbits and a very low and uncertain rainfall. The chance of discovering such plants is remote, and even if discovered, "there would remain the problem of their dissemination through vast areas with no regular growing season and an unimproved capital value rarely exceeding 2*s*. per acre".

### Mining in Canada

We have received the Report of the Department of Mines of the Dominion of Canada for the fiscal year ended March 31, 1935, and taken as a whole it may be said to be thoroughly satisfactory. The Report shows that the rise in the price of gold has caused renewed activity in that industry and states that "Canada's gold industry is contributing to the prosperity, not only of the communities in which operations are centred, but to the industrial life of the nation as a whole". Canada apparently is also reopening some of the silver camps for which it was famous a few years ago, but the "Department's work in fuels and non-metallics is becoming of increasing economic importance", and there has been a relatively small number of ore treatment investigations in connexion with base metal ores. There are full reports of the various divisions of the Department of Mines, commencing with a Bureau of Economic Geology, the National Museum of Canada and Mines Branches proper, together with an Explosives Division, an Editorial Division and an Accounting Division, which latter shows that something like a million dollars was available for the expenditure of the Department of Mines, and that nearly all of it was utilized. It is interesting to note that the Fuels and Fuel Testing Division was busily engaged throughout the year in question.

### Cotton Research in India

India is the second largest cotton growing country in the world, and the importance of the industry led the Indian Cotton Committee to set up a Technological Laboratory at Matunga some ten years ago. Research work and tests of direct importance to the cotton breeder, merchant and mill owner have been carried out in collaboration with the provincial agricultural departments, and a brochure has just been published by the Committee giving a full account of the activities of the Laboratory since its inception (Bombay: Indian Central Cotton Committee. 2 rupees). The two main objects of the work are to undertake spinning tests on improved varieties of cotton, and to establish relationships between the measurable fibre characteristics and the spinning quality. This second object aims at dispensing with the necessity of making spinning tests on large numbers of new strains, as it is hoped to be able to assess the performance of the cotton from a knowledge of its fibre properties. The development of the work may be judged from the fact that during 1933–34, 166 samples were tested in connexion with trade and technological problems, compared with only 28 in 1924–25, while as regards agricultural samples, 366 were tested in 1933–34, compared with 46 in the 1924–25 season. The problem of averting the possible danger of the introduction of the cotton boll-weevil through imported American bales has been successfully attacked. A satisfactory method of fumigation has been developed, and legislation enacted to ensure that all cottons imported from America are so treated. The brochure concludes with a complete list of publications issued from the Laboratory since 1925.

### The Science Museum Library

On entering a library for the purpose of obtaining information on a given subject, the first things the visitor wishes to know are what books or pamphlets the library possesses relating to the subject, and how is he to obtain them. There are usually card indexes available, but even with these at his disposal the reader may well be at sea unless he possesses a key to the system on which they are arranged. The publication of a new edition of the "Classification for Works on Pure and Applied Science in the Science Museum Library" (London: H.M. Stationery Office. 5*s*. net.) provides such a key to the finest science library in Great Britain. It should be studied by every one who uses the Library. It contains an explanation of the Universal Decimal Classification of the International Institute of Documentation in use at the Library, a list of about six thousand classes into which knowledge is divided for the purpose of indexing, and a copious alphabetical index comprising some five thousand entries. In the preface to the "Classification", Dr. S. C. Bradford says: "The titles on the cards in the Subject Catalogue are numbered and arranged in accordance with the Universal Decimal Classification. Under each number the titles are in chronological order. To ascertain what books the Library possesses on a given subject, readers are recommended to look first in the index, and then refer to the classification, before consulting the cards." By following this advice, those not already familiar with the system used in the Science Museum Library will undoubtedly save themselves both time and labour. It may be added that, in the last Report on the Science Museum, it was stated that the Library now possesses 252,515 volumes, the total of periodicals currently received is 9,468, while the Subject Matter Index contains 2,248,423 references.

### Progress in France of Electricity Supply

An account of electricity supply in France appears in *World Power* of July, as a translation of a paper in *La Journée Industrielle*. In 1923 the total installed capacity of electrical generating stations was 4½ million kilowatts. This increased to 10¾ million in 1935. There are 15 thermal and 5 hydro-electric

stations each having a capacity greater than 100,000 kw. The capacity has increased more rapidly than the output owing to the necessity of keeping a large reserve of power to meet sudden fluctuations in the consumption. In Paris, for example, the rate of consumption varies between 50,000 kw. at 3 a.m. and 340,000 kw. at 5 p.m. The rate of consumption of hydro-electric power is now greater than that of thermal power. It is noteworthy that the total length of the distributing lines is increasing more rapidly than the consumption of power. This is due to the increasing number of small consumers and to the fact that, as the supply service is extended to the more remote regions, longer lines are needed to reach new users. At present it is necessary to lay 46 metres of low tension line, on the average, to supply each new consumer, whereas in 1923 the length of line required was 13 metres. The large industries consume 7,100 million kwh. per annum and electrochemistry and electrometallurgy together take 2,200. Lighting and domestic supply take 1,800, small industries 1,000 and traction 900. There are now 35,369 communes supplied with electricity, and only about 2,600 not so provided.

### Protection against Gas Attacks

THE Socialist Medical Association has issued a booklet entitled "Gas Attacks: Is there any Protection?" (London: Lawrence and Wishart, Ltd. 6*d*.). It is maintained that air-raiders are certain to penetrate our defences, and will not hesitate to employ a combination of high explosives, fire and gas in their attacks, against which the only efficient protections are respirators and gas- and bomb-proof self-contained dug-outs. The booklet issued by the Home Office, "Anti-Gas Precautions and First Aid for Air-Raid Casualties", is criticized, and is considered to give an incorrect impression of the dangers of war gases and possibilities of protection, and that the defences proposed, even if they could be generally adopted, would be inadequate. Dr. Sommerville Hastings contributes an introduction, the nature of the gases employed and their effects are described, and the available means of protection and the treatment of gas casualties are discussed.

### Bulletin of the Metchnikoff Institute of the Ukraine

THE Metchnikoff Institute of the Ukraine has commenced the issue of a monthly bulletin (*Bulletin de l'Institut Metchnikoff*) devoted in the main to bacteriological and immunological papers from the Institute, written in French, English and German. In an editorial note to the first number (April 1936), it is remarked that until 1917 bacteriology had made slow progress in Russia, but that since that time many new institutes have been established and the active roll of bacteriologists and epidemiological experts has very greatly expanded. The nineteen extremely brief papers published in the first number are written in summary fashion without bibliographies, but any efforts that facilitate the introduction of Russian work to non-Russian readers are to be heartily welcomed.

### The *Aquarist and Pond-Keeper*

THE *Aquarist and Pond-Keeper*, incorporating the *Reptilian Review*, in the March–April number, 1936, has various improvements, including a new cover design. Specially striking is a collection of photographs occupying two pages, which with the illustrations to the article on reptile hunting in Britain by A. E. H., depict the whole of our native species of reptiles and batrachians. Mr. E. Bridgstock-Choat, honorary curator of the Erith Museum, contributes an article entitled "The Pond Hunter", which will be continued, and papers from various other workers deal with fishes, fish-breeding, ponds and water gardening and various allied subjects.

### Official Statistics

ATTENTION may be directed to the publication of the Guide to Current Official Statistics for 1935 (London: H.M. Stationery Office. Price 1*s*.). The arrangement is the same as in previous years. The greater part of the volume is occupied by an alphabetical range of subjects with reference to the appropriate publication. This is followed by a list of publications arranged under departments. The volume is invaluable for quick reference, and reveals the great range of matters on which statistical and other official information is available.

### Post-graduate Medical Research

THE Medical Research Council has decided to institute a series of studentships and fellowships to encourage young British medical graduates towards becoming investigators in those branches of medical science which are concerned directly with disease as it occurs in human beings. Six post-graduate studentships are therefore offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive an inclusive grant at the rate of £200 per annum, during a period not exceeding twelve months, while undertaking approved courses of study in Great Britain such as may be regarded as best calculated to advance the student's training in methods of research. Four research fellowships are also offered for candidates of similar qualifications who have already had some experience in research methods. Each fellowship will be tenable for one year at the value of £250 per annum, and will be renewable in approved instances at the rate of £300 per annum for a second year. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, London, S.W.1.

### Fireball over Yorkshire

THE occurrence on August 18 at about $22^h\ 23^m$ (Summer Time) of a brilliant object, evidently a fireball or particularly bright meteor, has been referred to by several correspondents in the *Yorkshire Post*. The accurate observation of the apparent path of a meteor requires a trained observer, and it is to be expected that accounts supplied by casual eye-

witnesses are often vague, conflicting, and quite unreliable for the data required to fix the real path above the earth. It seems, however, very probable that the fireball which lit up the countryside from which it was seen (including North Yorkshire, Derbyshire and Westmorland) was associated with the Perseid shower of meteors. This shower, which provides a high maximum frequency of meteors between August 10 and 12, is really operative from about mid-July until after mid-August; during this period the radiant point moves progressively from a position at about R.A. $1^h$ : Dec. $+50°$ to R.A. $4^h$ : Dec. 65°, or from a position in the constellation Andromeda, through Perseus (which gives the shower its name) to Camelopardus.

### The Night Sky in September

THE night sky of September offers a rich variety of objects for observation with slight optical aid. Some of the most attractive of the constellations are visible; there are star fields of the Milky Way, the Andromeda Nebula, the variable star, Algol, the Pleiades, some of the best known double stars and the largest two major planets. Between the first and last days of the month, the days shorten in the latitude of London by nearly two hours. On Sept. $23^d$ $5^h$ the sun enters, at the autumnal equinox, the sign Libra. Full moon occurs on Sept. $1^d$ $12\frac{1}{2}^h$ and again, as the Harvest Moon, on Sept. $30^d$ $21^h$. Of the planets to be observed, Venus still sets in the early twilight, but Jupiter is a bright object low in the south-west during the early evening. There is yet time, though very limited, for observing some interesting phenomena—transits, occultations and eclipses—associated with the four inner satellites. Particulars will be found on p. 615 of the *Nautical Almanac* for 1936. Saturn is above the horizon all night; on September 12 it is in opposition at a least distance from the earth of about 800 million miles. The rings appear nearly closed, the minor axis subtending an angle of only $1\frac{1}{2}$ seconds of arc. Mars is a morning star, and will be in conjunction with the bright star Regulus on September 24, when the angular distance between planet and star is less than 1°. Uranus is in Aries, and can be found near the 6th magnitude star $\omega$ Arietis, which the planet resembles when viewed with binoculars; but a 2- or 3-inch telescope will show the planet's disk of $3\frac{1}{2}''$ in diameter. The light variation of Algol ($\beta$ Persei) may be observed near the following times of minima: Sept. $3^d$ $3^h$, $6^d$ $0^h$, $26^d$ $2^h$, $28^d$ $23^h$, Oct. $1^d$ $19^h$ (add $1^h$ to convert to Summer Time). The following double stars are suitably placed for observation during September: $\alpha$ Herculis (separation of components $4\frac{1}{2}''$), $\epsilon$ Lyræ (3′ separation for the wide components each of which is a double of $2\frac{1}{2}''$ and $3''$ separation respectively), $\beta$ Cygni (34″) and $\gamma$ Delphini (11″).

### Announcements

PROF. MAX PLANCK, president of the Kaiser Wilhelm Society for the Advancement of Science, has been nominated doctor *honoris causa* by the Faculty of Philosophy of the University of Graz.

THE 1936 American Physical Education honorary award for achievement has been divided between the twin brothers, Dr. Edgar and Dr. Edwin Fauver, directors of physical education at Wesleyan University and Rochester University, respectively.

ON the occasion of the recent celebration of the twenty-fifth anniversary of the German Statistical Society the following were nominated honorary members: Prof. Sigmund Schott, director of the Mannheim Statistical Office; Dr. Friedrich Prinzing, of Ulm; Dr. Kovacs, president of the Hungarian Central Statistical Office, Budapest; and Dr. Savorgnan, president of the Italian Central Statistical Office, Rome.

DR. WILLIBALD SCHOLZ, professor of neurology and psychiatry at Munich, has succeeded the late Prof. Spielmeyer as director of the Department of Cerebral Pathology of the German Research Institute of Psychiatry, Kaiser Wilhelm Institute, Munich.

A NUMBER of public health courses have been instituted in Holland for training civilians in protecting themselves against attacks from enemy aeroplanes.

A SIX-year study of the role of diet in the last half of adult life will be undertaken at the New York State College of Agriculture at Cornell University. The Rockefeller Foundation has contributed 42,500 dollars to the support of the study.

THE second Italian Congress of Radiology will be held at Modena on September 20–21 under the presidency of Prof. Ruggero Balli, director of the Institute of Radiology. Further information can be obtained from the general secretary, Dr. Marco Lenzi, Istituto di Radiologia, Modena.

PROF. PAVLOV'S widow has presented the first batch of papers formerly belonging to her husband to the archives of the Academy of Sciences of Soviet Russia. They consist of about 2,500 letters from Russian and foreign men of science. Most of them relate to the years following the Revolution, while among the earlier ones are several from Metchnikoff and other famous men of science who corresponded regularly with Pavlov.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant (III) at the Ditton Laboratory, East Malling, Kent (refrigeration)—The Superintendent, Ditton Laboratory, East Malling, Kent (August 31).

Three inspectors (agricultural and live-stock) in the Department of Agriculture for Scotland—The Secretary (Establishment Branch), Department of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh, 2 (September 1).

A civilian education officer in the Royal Air Force Educational Service—The Secretary (A.E.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (September 14).

A visiting tutor for educational psychology in the Catholic Training College for Women, Cavendish Square, London, W.1—The Principal.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 369.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Structure-Factor Graphs for Crystal Analysis

WHEN unit cell and space group have been determined in crystal analysis by X-rays, the investigator tests various configurations of the atoms in the unit cell in order to obtain one which explains satisfactorily the observed strength of the diffracted beams with various index-triplets (*hkl*). For each configuration and each reflection (*hkl*), an appropriate 'structure-factor' can be calculated by the laws of optical interference. Large structure-factors correspond to strong reflections, and small structure-factors to weak reflections.

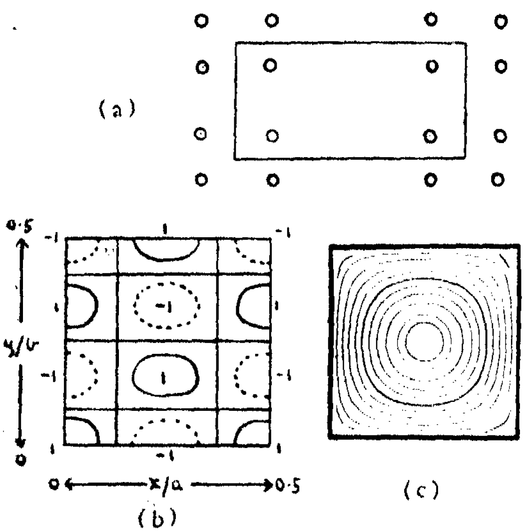

FIG. 1.

Once an approximation to the structure has been obtained, the fixation of the precise atomic positions is readily carried out by Fourier synthesis. The search for an approximate structure, however, is often extremely laborious, since in most cases a method of trial and error has to be used, and the structure-factor has to be computed for each tentative configuration. It is the purpose of this note to point out how greatly this labour is reduced by the use of *contoured graphs* of structure-factor.

It is usual to consider the projection of the structure on each face of the unit cell in turn, using the reflections around the corresponding zone in each case. 'General' reflections can then be used to test the structure so deduced. Although the number of space-groups is large, the number of symmetry types in the plane groups is restricted. A few formulæ for the structure-factor cover all cases.

As an example, the symmetry scheme shown in Fig. 1 (*a*) frequently appears in projections of monoclinic crystals on '*a*' or '*c*', and of orthorhombic crystals. An atom with co-ordinates $x$, $y$, along with the three other atoms to which it is related by the operation of the symmetry elements, gives a structure factor $4\cos(2\pi hx/a)\cos(2\pi ky/b)$ for the reflection ($hk0$). The function $\cos(2\pi hx/a)\cos(2\pi ky/b)$ is plotted in Fig. 1 (*b*) for the case $h = 2$, $k = 3$. In the graphs actually used in analysis contours are drawn for intervals of 0·1, but in this small-scale sketch only the zero lines and contours for 0·5 have been drawn. In the complete graph each small cell contains contours like those in Fig. 1 (*c*), suitably modified in horizontal and vertical scale. A set of graphs is prepared for all low values of $h$ and $k$.

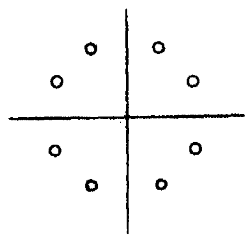

FIG. 2 *a*.

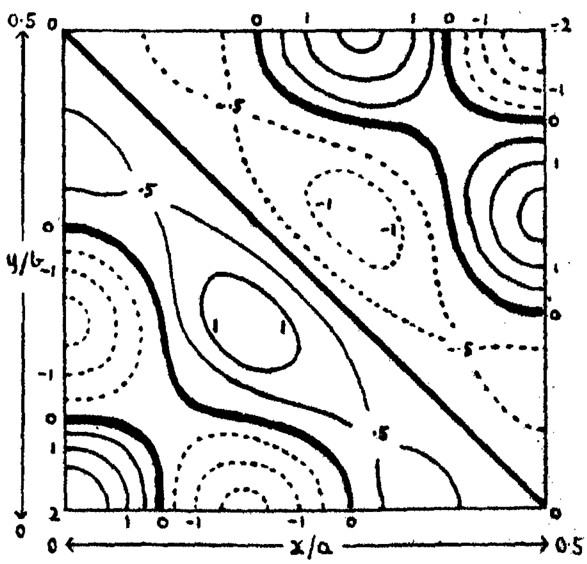

FIG. 2 *b*. Contours of the function $\{\cos(4\pi x/a)\cos(6\pi y/a) + \cos(6\pi x/a$ $\cos(4\pi y/a)\}$.

When an atomic configuration is being tested, the $x/a$ and $y/b$ co-ordinates of its atoms are plotted on a transparent sheet which fits over the graphs. Structure-factors can be read by inspection to two

figures, an amply sufficient accuracy. The principal merit of the graphs, however, is that the investigator can judge how the tentative configuration should be modified in order to make its structure-factor correspond to the observed value for each reflection, since the effect of moving an atom in a given direction and by a given distance is shown by the graph. The advantage of being able to do this will be appreciated by anyone accustomed to X-ray analysis.

By moving the origin from centre to corner of a small cell, the same graphs give values of $\sin(2\pi hx/a)\sin(2\pi ky/b)$. A single set of graphs, in fact, covers all cases of monoclinic and orthorhombic crystals for which the projection has a rectangular outline and a centre of inversion.

The advantage of the graphs is even greater in projections of tetragonal and hexagonal symmetry, when the atoms may be in groups of eight or twelve. The (230) graph for the tetragonal complex of Fig. 2 *a* is shown in Fig. 2 *b*. Such a graph considerably facilitates the adjustment of atomic positions. There are plateaux, for example, where the contribution of an atom varies very slowly, so that atoms in these regions give an approximately known contribution and attention may be concentrated on other atoms in 'sensitive' positions.

Trial has shown that analysis can be much more rapidly carried out with the graphs than by processes of calculation.

W. L. BRAGG.

Physical Laboratories,
University,
Manchester.
July 27.

## Molecular State of Proteins in Mixtures and Concentrated Solutions

BY means of the Svedberg high-speed ultracentrifuge it is possible to analyse mixtures of different molecular species, since the sedimentation involves a partial separation of the different sizes present. The concentration of the components may therefore be calculated from the sedimentation diagram. But during the study of protein mixtures in the ultracentrifuge it has often been observed that the concentration of the different sedimenting molecules thus calculated were not the same as those determined analytically. Generally the apparent concentration of the faster sedimenting molecule was smaller, when calculated from the sedimentation diagram, whereas it was higher for the slower sedimenting molecule. McFarlane[1], who first studied the problem on some artificial serum mixtures, thought that the effect was due to some specific interaction between the albumin and the globulin. Later, R. A. Kekwick and I studied some mixtures of serumalbumin and lactoglobulin. In this case serumalbumin, the faster sedimenting molecule, is found in too low concentration, and the lactoglobulin is found in too high concentration. From these experiments I concluded that the phenomenon was caused by some medium effect produced by the slower sedimenting protein molecules on the faster sedimenting ones, and that the effect was due to a real dissociation of the faster sedimenting molecules. If this is true, one would expect that it would be possible to produce the effect by means of lower molecular substances related to proteins, such as amino acids, polypeptides and protamines.

For the first two groups of these substances there was a measurable although very small effect. In the case of the protamine studied (clupein) the effect was very strong with serumalbumin, where it gave rise to new molecules with $s_{20}$ (= sedimentation constant) of about $1 \times 10^{-13}$ besides the ones with the normal $s_{20}(4 \cdot 5 \times 10^{-13})$. If we call the serumalbumin molecules with the normal $s_{20}$, $A$, and those of the dissociated serumalbumin, $B$, then the concentration ratio between these as calculated from the sedimentation diagram was: for a 5·3 per cent clupein solution $B/A = 1 \cdot 58$, for a 2·65 per cent solution $B/A = 0 \cdot 90$ and for a 1·1 per cent solution $B/A = 0 \cdot 36$. From these figures it is seen that the effect is by no means negligible since the dissociation product of serumalbumin in the more concentrated clupein solution is present in higher concentration than the undissociated serumalbumin. It is also very remarkable that all the sedimentation diagrams show only the presence of molecules with $s_{20} = 1 \times 10^{-13}$ and $s_{20} = 4 \cdot 5 \times 10^{-13}$ (besides a small amount of some association products); this probably indicates that the dissociation process always gives rise to molecules of the same size (perhaps one eighth of the original value). Some experiments with hæmoglobin show that this protein too is dissociated in the presence of other proteins and clupein, but here the sedimentation constant indicates that the dissociation at first gives molecules of half the original size, independent of whether lactoglobulin or clupein is used.

As the effect seems to be of a more general nature (whether it is a dielectric or chemical effect or a combined effect is at present impossible to decide) it is to be expected that it may also take place in a more concentrated solution of a uniform protein, and these solutions should therefore give a decreased molecular weight with increasing protein concentration. This may at least partly explain the fact that several investigations show that the proteins are behaving osmotically abnormally in that the ratio $\pi/c$ ($\pi$ = osmotic pressure, $c$ = concentration of protein) increases with increasing protein concentration, as it should do if the molecular weight is not constant, but decreases with increasing concentration.

Information about this effect may be of value in explaining some of the biological processes, where we are dealing with more or less concentrated protein solutions.

Further details will be given in a forthcoming paper in the *Biochemical Journal*.

KAI O. PEDERSEN.

Laboratory of Physical Chemistry,
University of Uppsala,
Sweden.
July 26.

[1] See, for example, A. S. McFarlane: *Biochem. J.*, **29**, 407 (1935).

## Effect of Phenylacetic Acid on the Growth of Tomato Plants

MUCH interest has been taken in the action on the growth of plants of various organic substances which has been described by the workers at the Boyce Thompson Institute[1,2]. They apply these substances in lanolin preparations to plants, or as a water solution added to the soil or injected into the stem; the main responses of the treated plants being

epinasty of the leaves, swellings and proliferations of the stems and petioles, and formation of roots on or near the treated part. In the course of some tests carried out at East Malling Research Station, using phenylacetic acid, I sprayed a batch of tomato plants with a 0·1 per cent solution in water, while control plants were sprayed with water containing a little alcohol. The solution was prepared as described by

FIG. 1. The plant on the left has been sprayed daily for two weeks with 0·1 per cent phenylacetic acid. Control on right sprayed with water.

Hitchcock and Zimmerman[3]. By the spray method, the amount of growth substance applied can be fairly accurately controlled. Entry was very rapid; epinasty of the leaves being visible after one hour in a greenhouse at a temperature of about 20° C. The plants were treated in the morning, and by the next day the leaves had fully recovered; moreover, very little stem bending had occurred, showing that the distribution of the growth substance was uniform throughout the stem. The treatment was continued daily, and groups of plants were harvested weekly; the fresh and dry weights being determined. Fig. 1 shows a treated and a control plant at the end of two weeks.

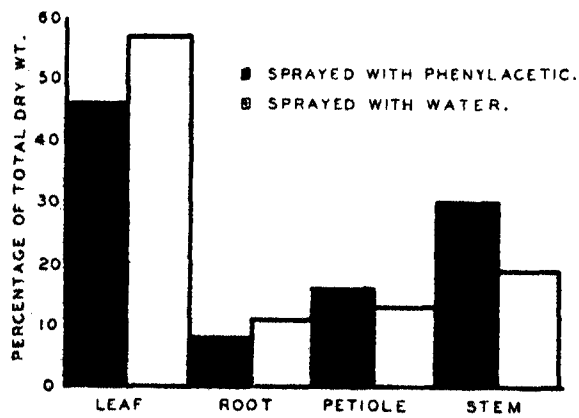


FIG. 2. Diagram showing the percentage of the dry weight present as stem, petiole, root and leaf after one week.

After one week the treated plants were more than thirty per cent taller than the controls, and the lengths of their petioles and internodes were also much greater. The diagram, Fig. 2, shows the percentage of the dry weight present as stem, petiole, root and leaf in the treated plants and the controls after one week.

From Fig. 2 it is seen that there are very significant alterations in the relative amounts of the various organs which make up the total dry weight of the plant. Thus the percentages of the total dry weight which are present as leaf and root have decreased, while the percentages present as stem and petiole have increased. These differences were maintained with little alteration after two and three weeks treatment. The water content of the treated plants had also increased indicating a more succulent type of growth. The total dry weight of the treated plants had not increased, however, and it would therefore appear that the growth substances may act not by increasing the growth of the plant as a whole, but by effecting the balance between stem, root and leaf.

If the treated plants were kept in a humid atmosphere, roots emerged from the stem after twelve to fourteen days. The spray method of applying the growth substance may therefore prove to be a convenient way of treating cuttings.

H. L. PEARSE.

Research Institute of Plant Physiology,
Imperial College of Science and Technology,
South Kensington, S.W.7.
July 29.

[1] P. W. Zimmerman and Frank Wilcoxon, *Contrib. Boyce Thompson Inst.*, 7, 209 (1935).
[2] A. E. Hitchcock and P. W. Zimmerman, *Contrib. Boyce Thompson Inst.*, 7, 447 (1935).
[3] A. E. Hitchcock and P. W. Zimmerman, *Contrib. Boyce Thompson Inst.*, 8, 63 (1936).

## Structure of the Wall of *Valonia*

THE interesting röntgenographic studies of O. L. Sponsler[1] and of W. T. Astbury, T. C. Marwick and J. D. Bernal[2] on the cell-wall of the large one-celled alga of the genus *Valonia* have revived the interest in the older microscopic investigations by C. Correns[3] on the structure of the cell-walls of Algæ, including also *Valonia*.

Correns proved that the wall of *Valonia* and of some other Algæ consists of a large number of lamellæ, each containing numerous parallel cellulose fibrillæ, which are placed spirally around the axis of the cell, which is more or less of a cylindrical shape. The fibrillæ of the various odd-numbered lamellæ are practically parallel, as are those of the even-numbered lamellæ—there occur deviations of a few degrees—but the direction of the winding of the spiral in the odd lamellæ is opposite to that in the even lamellæ. In the case of *V. ventriculosa*, Astbury found that the angle made by the two directions may vary from 80° to 60°; for some *Cladophora* species this approaches 90°, according to Correns.

Up to now any explanation of the method by which this remarkable structure has been brought about is lacking.

H. J. Denham[4] has observed that the protoplasm stream in the cells of the pili on the stamens of *Tradescantia virginica* near the cell-wall often runs exactly parallel to the longitudinal or steeply spiral stripes of this wall. It follows from a remarkable study by P. Martens[5] that these stripes do not occur, as Denham thought, on the inner surface of the wall, but on the cuticula which covers the outer side of the wall; the inner side of the thin cellulose layer, situated under the cuticula, is completely smooth. By studying the double refraction of the cellulose layer, and by means of swelling experiments, I have been able to prove that the rod-shaped cellulose crystallites in this

cellulose layer possess a 'statical preference' for the transverse direction. The layer has therefore a micellar structure which sometimes is called 'Röhrenstruktur'. The protoplasm courses approximately perpendicular to the direction which is most preferred by the crystallites in the cell-wall.

From a series of other important investigations of P. Martens[6,7] it follows that the markings on the cuticula very generally are indications of the tensions which occur therein by the active growth and the passive stretch of the cell-wall layer situated under the cuticula. The stripings on the cuticula of the pili of *Tradescantia* are really therefore the result of the fact that the cellulose layer lying underneath is most stretchable in the direction which is practically perpendicular to the one preferred by the crystallites. The relation referred to here between the direction of the greatest stretchability and the internal structure has been settled satisfactorily by R. Sonntag[8], P. Jaccard and A. Frey[9].

It may be assumed that the protoplasm lying directly against the inside of the cellulose layer, as a result of the stretching of that layer, is in a state of tension in the same sense as the cuticula, and that the protoplasm stream is *directed* by this tension along that layer. This explains the observation of Denham, which, through Martens' observations, had proved puzzling.

Various careful observations have been made by H. Crüger[10], L. Dippel[11] and E. Strasburger[12], from which it appears that the secondary thickenings which are often deposited on the inner side against the primary wall layer (not, however, in the case of the pili of *Tradescantia*, where the wall remains primary) are formed in the protoplasm streaming along the wall, and in such a way that it looks as if the protoplasm along the wall changes into wall substance. I directed attention in 1927[13] to the fact that the rod-shaped cellulose crystallites in such secondary thickenings are deposited in the direction of the protoplasm stream along the wall. The crystallites are probably arranged by the stream in the direction of the stream.

From the foregoing it will now be clear why, in numerous cell-walls, the direction of the crystallites in the secondary wall layer is more or less perpendicular to that in the primary layer. The direction of the crystallites in the secondary layer is hence determined by the direction of the greatest stretchability of the primary wall layer. In the case of a completely homogeneous wall structure the directions of the crystallites in the primary and in the secondary wall layer will therefore be *exactly* perpendicular to each other, but a priori deviations from this position may be expected.

The normal case appears to be that the secondary deposition begins after the stretchability of the primary wall has been greatly diminished, in such a way that after deposition has taken place, practically no stretch of the wall occurs. If one supposes, however, that after a secondary wall layer has been deposited the primary wall regains its stretchability by the intussusception of new cell-wall material, then the protoplasm near the wall will be subjected to a tension which is now perpendicular to the direction of the crystallites in the secondary layer. A tertiary layer will then be deposited, of which the crystallites are approximately perpendicular to those in the secondary. This process may repeat itself periodically, for example, by the strong passing increase each day of the turgor pressure in the cell, due to carbon dioxide assimilation in daylight. If one considers further that by the growing together of the rod-shaped cellulose crystallites placed next to, and end-on-end with each other, fibrillæ may be formed, then one may realize that the remarkable structure of the cell-walls of *Valonia* and other Algæ may be the result of the above mentioned process.

Applying the above train of thought, this structure should be effected by a periodic repetition of a process of wall thickening very generally found.

G. VAN ITERSON, JUN.

Laboratory of Technical Botany,
University College of Technology,
Delft.
July.

[1] "Orientation of Cellulose Space Lattice in the Cell Wall", *Protoplasma*, **12**, 241 (1931).

[2] "X-Ray Analysis of the Structure of the Wall of *Valonia ventriculosa*", *Proc. Roy. Soc. Lond.*, B, **109**, 443 (1932).

[3] "Zur Kenntnis der inneren Struktur einiger Algenmembranen", Zimmerman's Beitr. Morph. Physiol. Pflanzenzelle, **1**, 260 (1893).

[4] "The Structure of the Cotton Hair and its Botanical Aspects", *J. Text. Inst.*, **14**, 85 (1923).

[5] "Phénomènes cuticulaires et phénomènes osmotiques dans les poils staminaux de Tradescantia", *La Cellule*, **41**, 17 (1932–33).

[6] "Recherches sur la cuticule" (3), *Protoplasma*, **20**, 483 (1934).

[7] "Le relief cuticulaire et la différenciation épidermique des organes floraux", *La Cellule*, **43**, 289 (1934).

[8] "Die duktilen Pflanzenfasern, der Bau ihrer mechanischen Zellen und die etwaigen Ursachen der Duktilität", *Flora*, **59**, 203 (1909).

[9] P. Jaccard and A. Frey, "Einfluss von mechan. Beanspr. auf die Micellarstruktur u.s.w.", *Pringsh. Jahrb.*, **68**, 844 (1928).

[10] "Zur Entwickelungsgeschichte der Zellwand", *Bot. Z.*, **13**, 601, 617 (1855).

[11] "Die Entstehung der wandständigen Protoplasmaströmchen in den Pflanzenzellen", *Abh. Naturf. Ges. Halle*, **10**, 45 (1868).

[12] "Ueber den Bau und das Wachstum der Zellhäute", Jena, 1882.

[13] "De wording van den plantaardigen celwand", *Chemisch Weekblad*, **24**, 166 (1927).

## Insect Coloration and Natural Selection

IN NATURE of August 8 there appear two letters on the subject of natural selection: one from my friend, Prof. H. E. Armstrong, and another from my friend, Prof. Hale Carpenter. Prof. Armstrong in his attack on "Natural Selection" quotes me. Prof Carpenter in his reply thinks that Prof. Armstrong's objections are easily answered. At the risk of appearing tedious, I desire to make one more effort to bring home to Prof. Carpenter the insuperable objections which exist to the explanation of "mimicry" or any other biological phenomenon whatever from "natural selection".

By mimicry Prof. Carpenter means the theory that superficial resemblances between different groups of butterflies and similar resemblances between flies and beetles, etc., resemblances in colour or shape or attitude, have the function of enabling the weaker of the two to escape its enemies. Every part of an animal has some relation to its life, which is a constant reaction to its environment, but whether these resemblances really act in the way in which Prof. Carpenter supposes is an open question. Certainly one is not convinced by his *obiter dicta*. Each case requires a renewed and critical examination, which so far it has not received. I need only say that two of the most distinguished entomologists living, Dr. McAtee, of the U.S. Biological Survey, and Dr. B. P. Uvarov, who first elucidated the problem of the migratory locust, repudiate the "natural selection" explanation of mimicry. Worse than all is the statement by Bergh in his "Nomogenesis", that the only case on record of a species of butterfly being seriously decimated by birds is that of a Danaid—a supposedly distasteful species—in Ceylon.

Even if Prof. Carpenter were proved to be right, however, and these "mimicking" resemblances really did function in the way he supposes, "natural selection" would be incompetent to explain them. "Natural selection" in a sense is a truism; it merely asserts that an organism exists and maintains itself, which is sufficiently obvious. But what the theory covertly assumes is that random inheritable variations in all directions are constantly taking place by *chance*—and that is simply not true. All the experimental evidence obtained by testing this point has given the same answer, and it is surely unsafe to base any biological theory on an assumption which has proved to be false. But it may be answered that 'mutations' are inheritable. Mutations have now been artificially produced, and always by similar experiments. If the eggs or young embryos are exposed to noxious conditions, then a large number are killed; some survive and develop normally whilst there is a border group of what we may term the 'half-killed' which develop into mutations. All mutants compared with the type are defective in vigour and viability. Mohr, the great authority on *Drosophila*, has constructed a scale of mutations: the slight mutations produce a slight effect on viability, the more obvious ones a greater effect, the most obvious a semi-lethal effect. Moreover, if mutants can be restored to normal conditions, after a certain number of generations they revert to normal development, and the mutant appearance which Johannsen defined as a "superficial disturbance of the chromosomes" passes off. No mutation has ever given rise to a natural race.

We have definite evidence that insects, like other animals, react to changes in the environment by changes in growth and appearance, and that when these changes in the environment are long continued, their effects become so engrained in the constitution that they are in ever-increasing measure inherited by the offspring. This has been proved by Heslop Harrison for the egg-laying habits of *Pontania salicis*, by Durkheim for the coloration of Pierid pupæ, for feeding habits by Miss Sladden and, *mirabile dicta*, for the colour of the imago of butterflies by Weismann himself.

When fully documented evidence for evolution as displayed by a minute study of species and races of living forms or by the study of lineage series in fossils is carefully studied, this dependence of evolutionary change on change in habit and function becomes apparent. It is useless to demand miracles in the shape of supposedly beneficial mutations to explain changes where the full evidence is not at hand. When and if it is available, I am convinced that apparently inexplicable cases will yield to the same explanation of inherited habit as those cited above.

E. W. MACBRIDE.

West Bank,
Alton,
Hampshire.

## The External Forces Acting on Chromosomes

ACCORDING to Darlington[1], in somatic mitosis or meiosis, "the equilibrium position reached at metaphase may . . . be described as the result of the combination of three kinds of repulsion acting on bodies in the confined space of the spindle", the repulsions being between chromosomes, between spindle attachments, and between poles and spindle attachments. If therefore at the first metaphase of meiosis there should exist two kinds of bivalents the different shapes or sizes of which cause the spindle attachments of the component chromosomes to be farther apart in one kind than in the other, we should expect the former type of bivalent to be pushed to the edge of the plate.

In the plant *Silene Otites* Wibel, the chiasmata at first metaphase are all terminal or nearly so, and a mixture of rod bivalents with one chiasma and ring bivalents with two chiasmata is found, the spindle attachments being farther apart in the rod bivalents. The latter tend regularly to be arranged on the edge of the plate, a minor, but none the less striking, verification of the theory.

FIG. 1. Two polar views of the first metaphase of meiosis in pollen mother cells of *Silene Otites* Wibel. For the purpose of illustration the bivalents with one chiasma are shown in outline. (× 3000 approx.).

In the polar views represented in Fig. 1 the bivalents with one chiasma can be distinguished by their smaller and more circular cross-section. The illustrations represent an apparent contradiction of the general rule that the largest chromosomes are found on the outside of the metaphase plate, but actually, as can be seen more clearly in side views, the difference is one of shape rather than of size.

JAMES L. FYFE.

School of Agriculture,
Cambridge.
July 16.

[1] C. D. Darlington, "Recent Advances in Cytology". J. & A. Churchill, London, 1932.

THE different distribution of rod and ring bivalents found by Mr. Fyfe in *Silene* is a clear and hitherto unnoticed example of the principle of repulsion-equilibrium in the formation of the metaphase plate. This effect evidently depends on the numbers of chromosomes, on the equality of their sizes combined with the variation in the number of their chiasmata, and on a certain size-relationship of chromosomes and spindle. Less conclusive evidence of the same distribution is to be found in my figures of *Primula sinensis*[1], *Campanula persicifolia* and diploid *Tradescantia*. In the last case the body-repulsions assist in producing the differential effect. Where the chromosomes are more numerous, as in *Aesculus*[2], the differential distribution is not clear without statistical treatment.

The detailed study of the congression and distribution of the bivalents on the plate in relation to their size and chiasma structure makes it possible now to describe the forces at work with more precision than a few years ago, especially in showing that the repulsions are an inverse function of distance[3].

C. D. DARLINGTON.

John Innes Horticultural Institution,
London, S.W.19.

[1] *J. Genetics*, 24, 65 (1931).
[2] Upcott, *J. Genetics*; in the press.
[3] MS. in the custody of the Royal Society (1935).

## Provisional Computation of the Plane Vibration Frequencies of Symmetrical Deuteroethylenes

SEVERAL workers[1,2] have developed the theory of the vibration spectrum of ethylene and have deduced from the experimental data values for some of the force constants occurring in the potential energy function of the molecule. A recent investigation by Bonner[3] has improved our knowledge of the vibration spectrum of ethylene.

The most general potential function for plane deformations which is compatible with the admitted symmetry of that molecule contains 15 constants. On the other hand, as there are 9 plane normal modes, it seems at first that only 9 constants of force can be determined from the present data. However, in order to reach a precision in accord with the accuracy of some data (1 cm.$^{-1}$), 11 constants are necessary, owing to reality conditions to be satisfied. Such a numerical potential function has been calculated for ethylene from Bonner's experimental data and checked by recomputation of the vibration frequencies with less than 0·15 per cent error.

Assuming that the potential function is not altered when 'heavy' hydrogens are present in the molecule, the vibration spectrum of $C_2D_4$ was readily obtained. The spectrum of each of the three isomers $C_2D_2H_2$ was calculated from two secular equations, one of the fifth degree, the other of the fourth. Each of them results from coupling together two families of normal modes of different symmetries in the completely symmetrical molecule $C_2X_4$, in such a way that a mode of the isomer of lower symmetry is produced. The coupling occurs through the kinetic energy function only, which has a lesser symmetry for the isomeres than for $C_2X_4$.

| | $C_2H_4$ | $C_2D_4$ | HDC : CDH *cis* | HDC : CDH *trans* | $H_2C:CD_2$ |
|---|---|---|---|---|---|
| 1 | $S_1$ 1621·3 | $S_1$ 1428·8 | $\pi'$ 1516·5 | $S$ 1514·2 | $\pi$ 1555·3 |
| 2 | 3019·0 | 2283·9 | 3065·0 | 3040·2 | 3004·3 |
| 3 | 1343·9 | 1008·9 | 2304·2 | 2291·2 | 2221·0 |
| 4 | $A_1$ 2988·0 | $A_1$ 2152·5 | 1247·9 | 1240·2 | 1357·8 |
| 5 | 1444·0 | 1072·8 | 752·7 | 807·9 | 1043·1 |
| 6 | $S_2$ 3069·0 | $S_2$ 2308·0 | $\sigma'$ 3031·1 | $A$ 3053·2 | $\sigma$ 3088·1 |
| 7 | 950·0 | 758·3 | 2228·9 | 2233·4 | 2316·3 |
| 8 | $A_2$ 3107·0 | $A_2$ 2325·0 | 1295·4 | 1308·4 | 945·6 |
| 9 | 949·7 | 678·1 | 820·2 | 765·3 | 724·8 |

The horizontal lines separate the frequencies in different symmetry families. $S$ and $A$, respectively, mean symmetric and antisymmetric with respect to the centre of the molecule. $S$ frequencies are Raman active and infra-red inactive; the reverse is true for $A$ frequencies. $\pi$ and $\sigma$ respectively mean symmetric and antisymmetric with respect to the carbon axis and $\pi'$ and $\sigma'$ the same with respect to the perpendicular axis in the plane of the molecule. They are all active in Raman effect and in infra-red absorption, but may be of widely different intensities. The $\pi$ and $\pi'$ frequencies are polarized and expected strong Raman lines, whereas the $\sigma$ and $\sigma'$ are depolarized and weaker. As is well known, for $C_2H_4$ and $C_2D_4$, $S$ frequencies divide into two separate families $S_1(\pi\,\pi')$ and $S_2(\sigma\,\sigma')$ and also $A_1(\pi\,\sigma')$ and $A_2(\pi'\,\sigma)$. The $\pi$ frequencies show a marked $Q$ branch in the infra-red absorption. The four fundamental symmetry families of the totally symmetric molecule combine in the following way to form the normal modes of the three isomers: $\pi'(S_1A_2)$; $\sigma'(S_2A_1)$; $\pi(S_1A_1)$; $\sigma(S_2A_2)$; $S(S_1S_2)$; $A(A_1A_2)$.

Owing to the uncertainty resting upon some data and also the neglect of the anharmonicity, no too close fit with the experiment can be hoped. However, it is expected that the obvious qualitative relationships existing between the spectra of heavy ethylenes will hold.

C. MANNEBACK.
A. VERLEYSEN.

Institute of Physics,
Louvain.
July 27.

[1] Sutherland and Dennison, *Proc. Roy. Soc.*, A, **148**, 250 (1935).
[2] Delfosse, *Ann. Soc. Sci. Bruxelles*, B, **45**, 114 (1935).
[3] Bonner, *J. Amer. Chem. Soc.*, **58**, 34 (1936).

## Some Properties of Pentadeuterobenzoic Acid, $C_6D_5COOH$

THE acid was obtained by the reaction between pentadeuterophenyl magnesium bromide and carbon dioxide[1]. The following details enable a comparison to be made between this acid and benzoic acid:

| | $C_6H_5COOH$ | $C_6D_5COOH$ |
|---|---|---|
| Melting point: | 121·7° C. | 120·9° C. |
| Solubility in 100 c.c. water at 18° C: | 0·28 gm. | 0·34 gm. |
| Molecular heat of combustion: | 771400 cal. | 761380 cal. |
| Dissociation constant at 25° C.: | $6·6 \times 10^{-5}$ | $6·6 \times 10^{-5}$ |

A detailed account of this work will shortly appear in *Helvetica Chimica Acta.*

H. ERLENMEYER.
A. EPPRECHT.

Chemical Institute,
University of Basle.
July 29.

[1] Erlenmeyer, Lobeck und Epprecht, *Helv. Chim. Acta*, **19**, 793 (1936).

## Nuclear Reactions due to Neutrons of 2 m.e.v. Energy

MOST neutron workers hitherto have used Ra-Be, Ra-B or Ra-F as sources; these yield neutrons with continuous ranges of energies extending up to several m.e.v. The D – D nuclear reaction is considered to yield a homogeneous group of neutrons of about 2 m.e.v. energy. It is of interest, therefore, to know whether or not D – D neutrons can excite the nuclear reactions of the non-capture type reported by investigators using the radioactive sources.

We have been working in the Clarendon Laboratory with the neutrons obtained by bombarding heavy hydrogen with heavy hydrogen ions. The source of ions was a low-voltage arc of a modified Tuve and Dahl type. The total ion currents used have been of the order of 100 microamps. The accelerating voltage was 225 kv. Heavy phosphoric acid has proved to possess reasonably good lasting qualities as a target material. The yield of neutrons, as measured by the 2·3 min. induced activity of silver, has been checked at intervals over fifty hours' intermittent use, and has shown a constancy well within 10 per cent. Continuous runs of up to six hours' duration have been made.

With the exceptions of silicon and iron, the element under investigation was itself exposed to the 2 m.e.v. neutrons and then tested for induced radioactivity by means of a thin-walled Geiger-Müller counter. Silicon and iron were irradiated as $SiO_2$ and FeS respectively.

Silicon and phosphorus (half-periods, 2·5 min.) and phosphorus (half-period, 2·5 hr.) have been reported upon by Bjerge and Westcott[1]. They found a measurable activity only in the case of the 2·5 hr. period of phosphorus.

We have bombarded the following elements with our 2 m.e.v. neutrons for times up to twenty minutes in order to test for the shorter period activities: manganese and chromium (half-period, 3·75 min.), aluminium (10 min.), zinc (5 min.), silicon (2·3 min.). Any activity induced was certainly less than 1 per cent of the activity-value for phosphorus (2·5 hr.) irradiated to saturation under the same conditions.

Exposures for times up to three hours were carried out on zinc (half-period, 6 hr.), iron (2·5 hr.) and nickel (20 min.). No activities were found greater than 2 per cent of the saturation phosphorus value.

Calcium (16 hr.), magnesium and aluminium (15 hr.) were irradiated for periods up to six hours. Here again, our counter showed no activity as high as 2 per cent of that of phosphorus.

Naturally, any of these reactions might yield a positive result with a stronger source of neutrons or, in the case of the long-period ones, with a longer period of irradiation. We are making alterations which should greatly increase the number of neutrons available. Further investigations will be made on the above and other elements.

E. T. BOOTH.
C. HURST.

The Clarendon Laboratory,
Oxford.

[1] NATURE, 134, 177 (1934).

## Ultra-Violet Absorption Spectrum of Hæmoglobin

IN a previous communication (Adams[1] *et al.*, 1934) it was shown that the ultra-violet band at 4100 A., which is characteristic of hæmoglobin and its immediate derivatives, is not found in unlaked blood. This observation has been extended to several species and confirmed in all cases.

It has been found that the difference in physical state is not responsible for the absence of the band when the hæmoglobin is in the corpuscle. The cell volume was varied by placing the cells in solutions of different osmotic strength, but not more than 5 per cent variation in light absorption was observed. Precipitation of the hæmoglobin with a protective colloid gave a suspension of hæmoglobin with a density about equal to that of a blood corpuscle suspension. This preparation, although similar in physical properties to a cell suspension, displayed the same ultra-violet absorption spectrum as hæmoglobin in solution.

The explanation for the non-appearance of the band in the corpuscle was next sought in the possible combination of hæmoglobin with some constituent of the red blood cell to give a compound with no specific absorption at 4100 A. Attempts to combine cholesterol, lecithin, glutathione and lipid extracts of the cells with hæmoglobin did not yield substances which lacked the band at 4100 A. 'Stromatin', or stroma protein, was prepared by Jorpes' method[2] (1932). The pure protein does not exhibit any selective absorption in the 4000 A. region. However, if a small percentage of hæmoglobin or methæmoglobin remained as an impurity in the preparation, the hæmoglobin band was absent.

This suggested a combination between hæmoglobin and stromatin to give a substance with no absorption at 4000 A. A small amount of pure stromatin was mixed with dilute hæmoglobin in alkaline solution. The spectrogram was taken at once, and at regular intervals for several hours afterwards. The mixture was kept at 37° C. The results show that, after heating at this temperature for 30 minutes, the ultra-violet band of hæmoglobin began to disappear, and at the end of one and a half hours there was no trace of selective absorption at 4100 A. The experiment was controlled by treating hæmoglobin with the same amount of alkali in a similar way.

The results of these experiments lead to the conclusion that neither the crude lipids of the red blood cell, cholesterol, lecithin, or glutathione react with hæmoglobin in such a way as to change the specific absorption of hæmoglobin in the region of 4100–4200 A. On the other hand, pure stromatin does react with hæmoglobin to cause the disappearance of its specific band at 4100–4200 A.; and it is suggested that this same combination exists in the red blood cell, and is responsible for the lack of the specific absorption band in corpuscle hæmoglobin. Such an entity is apparently quite labile, since hæmolysis by a wide variety of agents causes the breakdown of the substance.

G. A. ADAMS.

Department of Biochemistry,
University of Western Ontario,
Medical School,
London, Canada.
July 25.

[1] G. A. Adams, R. C. Bradley and A. B. Macallum, *Biochem. J.*, 28, No. 2, 482–485 (1934)

[2] E. Jorpes, *Biochem. J.*, 26, No. 2, 1488 (1932).

## Potassium in the Brain in Vitamin $B_1$ Deficiency

IT has been stated that there is increased amount of potassium in the brains of pigeons suffering from vitamin $B_1$ deficiency. In view of the general interest attached to potassium salts and phenomena of excitation, I have re-examined this question. Unfortunately, I cannot find any significant difference between the amounts of potassium in the brains of normal and vitamin $B_1$ deficient pigeons, the values being 3·6 mgm. per gram of tissue in each case. The changes obtained by these authors[1] cannot, therefore, have been due to the avitaminosis.

HENRY W. KINNERSLEY.

Department of Biochemistry,
Oxford.
July 28.

[1] Ballif and Gherscovici, *C. R. Biologie*, 115, 75 (1934).

## Kinetics of an Inverse Diene Synthesis in the Pure Liquid State

THE decomposition of di*cyclo*pentadiene into *cyclo*pentadiene is an inverse diene synthesis. It was found previously[1] that in paraffin solution the reaction is monomolecular and that the rate constant is given by $k = 6{\cdot}0 \times 10^{12}\, e^{-34000/RT}$ sec.$^{-1}$.

The rate of the decomposition has now been measured in the pure liquid state, using a method by which the *cyclo*pentadiene was continuously removed from the reaction mixture. Measurements have been carried out between 100° and 155°, and within this range the Arrhenius equation is obeyed. The value

of the rate constant is $k = 3 \times 10^{13} e^{-35400/RT}$ sec.$^{-1}$, and the close agreement with the above figure shows that the mechanism of the inverse diene synthesis is the same both in solution and in the pure liquid state.

B. S. KHAMBATA.
ALBERT WASSERMANN.

University College,
London.

[1] NATURE, 137, 496 (1936).

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THE formation of di*cyclo*pentadiene from *cyclo*pentadiene is a diene synthesis and the reaction is bimolecular in benzene[1] and in paraffin solution.

If rate measurements in the pure liquid state are carried out it has to be considered that the 'solvent' originally present (*cyclo*pentadiene) is changed into a new solvent (mixture of *cyclo*pentadiene and di*cyclo*pentadiene). Hence it is not surprising that in each run a gradual change of the bimolecular rate constant ($k$) is observed. The constants characteristic of pure *cyclo*pentadiene are obtained if the observed $k$ values are extrapolated to zero time. Both the extrapolated constants and those observed in benzene or paraffin solution obey the Arrhenius equation. The 'temperature independent factors' ($Z$) and the activation energies ($E$) are given in the accompanying table.

| Reactants | Solvent | $Z$[1]/gm.mol.sec. $\times 10^{-6}$ | $E$ kgm.cal. |
|---|---|---|---|
| *cyclo*Pentadiene | Benzene | 1·2 | 16·4 |
| *cyclo*Pentadiene | Paraffin | 13 | 17·4 |
| *cyclo*Pentadiene | *cyclo*Pentadiene | 0·4[2] | 16·1[2] |

The accuracy of $E$ is 5–10 per cent. It can be seen that the $E$'s agree within the limits of experimental error. Further, the $Z$ values and hence the collision numbers between solute-solute molecules and between solute-solvent molecules are of the same order of magnitude.

ALBERT WASSERMANN.

University College,
London.

[1] NATURE, loc. cit.; *J. Chem. Soc.*, 1028 (1936).
[2] These values were calculated using unpublished measurements and the data given by Stobbe and Reuss, *Annalen*, 391, 151 (1901), Barret and Burrage, *J. Phys. Chem.*, 37, 1029 (1933) and Kistiakowsky and Mears, *J. Amer. Chem. Soc.*, 58, 1060 (1936).

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## Points from Foregoing Letters

THE use of contoured graphs for determining the configuration of atoms in crystals, from X-ray data, is explained and illustrated diagrammatically by Prof. W. L. Bragg. The analysis of atomic positions, it is claimed, can be more rapidly carried out with the graphs than by calculation.

The addition to serumalbumin solution of a protein (clupein) changes the sedimentation constant. The effect, according to Dr. K. O. Pedersen, is probably due to dissociation into molecules of perhaps one eighth the original size. This, the author considers, may be a general phenomenon which occurs with increasing concentration, even in solutions of a single protein, and may account for the abnormal increase in osmotic pressure with increased concentration of protein solutions.

A method of applying organic growth substances to plants by spraying is described by Dr. H. L. Pearse. Tomato plants sprayed with a dilute solution of phenylacetic acid showed increased growth in stem and petiole, with decreased growth in leaf and root.

Algæ of the genus *Valonia* form very large bladder-shaped cells. By X-ray, microscopical and optical investigation of the wall, it may be shown that sub-microscopical rod-shaped cellulose crystals (crystallites) are present. The wall consists of about forty lamellæ; in the odd-numbered lamellæ all rods are parallel to each other, and in the even ones also, but in a direction which forms a large angle with the direction of the crystallites in the odd lamellæ. Prof. G. van Iterson, jun., gives an explanation of the way in which this structure is developed.

In connexion with the discussion on the origin of mimicry in insects, Prof. E. W. MacBride disagrees with the view that random inheritable variations in all directions constantly take place by chance. He considers that animals react to changes in environment and, when these are long continued, their effects are increasingly inherited by the offspring.

Diagrams showing the position of chromosomes during the metaphase stage of the reduction division (meiosis) in pollen mother-cells of *Silene Otites* are submitted by J. L. Fyfe; they agree with the view of Dr. C. D. Darlington, that the configuration is determined by repulsion forces. Commenting on this communication, Dr. Darlington refers to additional evidence in support of his theory and states that the repulsions are inversely proportional to the distance.

A table giving the vibration spectra of several ethylenes containing heavy hydrogen ($C_2D_4$ and each of the three isomers $C_2D_2H_2$) is given by Prof. C. Manneback and A. Verleysen. The values were calculated from the known vibration spectrum of ordinary ethylene, by assuming that the 'potential function' is not altered when heavy hydrogens are present in the molecule.

The melting point, solubility, heat of combustion and dissociation constant of benzoic acid containing five heavy hydrogen atoms in the molecule are reported by Prof. H. Erlenmeyer and A. Epprecht.

No appreciable radioactivity has been observed by E. T. Booth and C. Hurst after irradiating, for periods varying from twenty minutes to six hours, substances containing various elements with neutrons of two million electron volts energy; these were obtained by bombarding heavy hydrogen with heavy hydrogen ions, using total ionic currents of 100 microamp. and an accelerating voltage of 225 kv.

Hæmoglobin as found in blood corpuscles differs from the prepared 'laked' variety in that it does not show an absorption band in the ultra-violet at 4100 A. G. A. Adams, after investigating the effect of several substances, finds that the addition of stroma protein (stromatin) causes hæmoglobin to lose its absorption band at 4100 A., and concludes that hæmoglobin occurs in blood in combination with stromatin.

# Research Items

## Marriage among Serbian Gypsies

IN continuation of his studies of the Serbian gypsies, Dr. Alexander Petrovič deals with marriage (*J. Gypsy Lore Soc.*, Ser. 3, 15, 3), drawing his material from Belgrade, Kragujevač and the neighbourhood of Arandjelovač, Rogatica, and Srebrnica. The gypsies from the two latter are Mahommedans, the remainder Orthodox. The marriage age is—Orthodox, boys, 13–18, girls, 12–16; Mahommedan, boys, 15–20, girls, 14–16. The later age among the Mahommedans is due to their custom of purchase, which involves a large sum. Neither bachelors nor old maids exist among the Christians, and to remain unwed is a disgrace. In olden times, marriages were celebrated at a much earlier age. The older generation used to betroth their children at 7–10 years and sometimes even before birth. In marriages in which the groom is very young, the bride usually being older by many years, it is customary for the father, or even grandfather, to be intimate with the bride in order to prevent her running away. These marriages secured a life-long bread-winner for the husband. Another reason given for early marriage is to ensure the descent in the male line and inheritance of the 'Slava' (patron saint) with the duty of celebrating his feast, as well as of burning candles in church for the parents after their death. The marriage is arranged by the father of the boy or the oldest man in the family. It is characteristic that when once a gypsy has decided on marriage, there is no delay. In marriage rites there is a tendency to imitate the customs of the neighbouring villages. Among some of the distinctive gypsy customs recorded is the pricking of a willow tree three times with a knife; while one of the chief marriage customs of all Serbian gypsies, but now no longer observed, was marriage around a tree. Even now, at Srebrnica, ties of marriage celebrated around a willow tree are considered more sacred than those celebrated by the 'Kadija'. In Mirijevo, the willow "symbolizes the woman". The rite of exposing evidence of virginity is widespread, as strict views are held on the subject of the virginity of the bride.

## Tattooing in China

PROF. CHUNGSHEE H. LIU has initiated a historical survey of tattooing in China by a study of the practice as it still exists among the aboriginal Li people of the island of Hainan, southern China, which he contributes to the newly founded *Journal of Science*, published by the Sun Yatsen Institute for the Advancement of Culture and Education, Nanking. Tattooing is recorded under the Shang and Chou dynasties, when it was practised to avoid the trouble of dragons and snakes. No evidence for the custom can be traced among the 'Southern Barbarians' of the Middle Kingdom, where it might be expected. Among the Li, where it is called 'tatan' (cf. Polynesian 'tatu'), there are two traditions of its origin. According to one, it was a tradition of their ancestors that they might recognize their descendants easily; according to the other, when a mother and son were the only survivors of a great deluge, the former disguised herself by it from her son's recognition at God's bidding in order that the earth might be repeopled. Tattooing is practised only by the women. The instruments used are a rattan needle and bamboo rod, with black ash, or Chinese ink. The designs are first drawn. The technique is not of a high standard, and is known to most old women. The designs may be divided into four groups: (1) oblique lines in twenty-seven forms, mostly used on the face; (2) horizontal lines in seventeen forms, mostly on the legs, but partly on the arms; (3) circular lines, twenty-five forms, mostly on the chin; and (4) linguistic forms, recorded only among the Pai-sha Li, and unintelligible. The practice may be interpreted as a system of tribal marking, as related to marriage, or the totemic idea, as a magic symbol, or as purely decorative. The custom is dying out, and should be studied further before complete extinction.

## Respiratory Dust Disease in the Cotton Industry

COTTON spinners do not suffer more than operatives in many other dusty occupations from respiratory tuberculosis, bronchitis and pneumonia; but cotton 'strippers' suffer a bronchitis mortality more than double that in other dusty trades. These operatives remove the dust from the carding machines, which comb out the cotton fibres, producing much dust in the process. The cause of this excessive mortality from bronchitis among these hands has been investigated by Prof. Carl Prausnitz (formerly of Breslau) in Prof. Maitland's Department at the University of Manchester, and his conclusions are published in a Report to the Medical Research Council (Special Rep. Series, No. 212. London: H.M. Stationery Office, 1936. 2*s*. 6*d*. net). Chemical examination showed that three fractions may be extracted from the dust, a lipoid or waxy fraction with petroleum ether, histamine with alcohol, and protein with saline solution. The lipoid is apparently quite harmless, the histamine has also a doubtful role as a disease-producing agent, but the protein is definitely toxic, causing irritant effects and inflammatory lesions in the deeper tissues. It also causes a condition of allergic hyper-sensitiveness; this was demonstrated by animal experiments, and was found to be present in all diseased cotton operatives examined. Various treatments for mitigating the disease are suggested, but the leading principle consists in prevention. This may necessitate the provision and use of adequate respirators, for even powerful and properly directed ventilation fails to carry away the lightest and smallest particles of dust.

## Seals in Cornwall

COMPLAINTS by fishermen in Cornwall regarding the damage caused to fisheries of mullet and herring by seals have led to a careful survey of the seal population by G. A. Steven (*J. Mar. Biol. Assoc.*, 20, 493; 1936). The only seal observed by him on the Cornish coasts was the grey seal, *Halichoerus grypus*, and its habit was to frequent, during the rest of the year as well as during the breeding season, caves which were inaccessible from the land side. During the survey (August 7–20, 1935) the numbers counted indicate a seal population on the north coast of not less than 300 and probably not more than 500; on the south coast the number, not estimated, is very

small. This differs very markedly from the estimate of 2,000 adhered to by the Cornwall Sea Fisheries Committee, and seems a much more trustworthy basis upon which to discuss any steps contemplated for the reduction of the seal population in the interests of the fishermen.

### Larval Transplantation in Axolotl

KOLODZIEJSKI (*Bull. Internat. Acad. Polonaise*, Feb. 1936) reports the results of implanting axolotl larvæ upon hatching or within the first week or so in axolotls eight months old; all the implants were the offspring of the same parents. The skin of the back of the larvæ was cut, and they were inserted into holes in the dorsal fin of the host so that the tissues of the two animals could grow together. In some experiments the host skin grew over the implants, in others the implant fell off, but the majority fused successfully. The growth of the implants was fairly rapid at first, slowed down at four months and ceased altogether at six months, although some were kept alive for fifteen months. The internal organs of the implants developed more or less normally, but the external parts exhibited a wide range of abnormalities. Generally the body and tail were much reduced and the hind limbs entirely absent, while the fore limbs were often present and normally developed, and the head in some developed for several months. The reflexes and motility of the implant were independent of those of the host and were more developed where the body form more nearly approached the normal. Many implants had well-developed testes with motile spermatozoa, and while this condition was more common in those on male hosts it also occurred in those on female hosts. The lips of the cloaca were usually wide open, and in implants on male hosts the cloacal lips were markedly developed independently of the stage of maturity of their own gonads.

### Morphology and Distribution of Penæids

MR. MARTIN D. BURKENROAD now concludes his preliminary review of the Penæidæ begun in two papers dealing chiefly with the littoral members of the family (1934 *a* and *b*) ("The Aristaeinae, Solenocerinae and Pelagic Penaeinae of the Bingham Oceanic Collection. Material for a Revision of the Oceanic Penaeidae". *Bull. Bingham Oceanographic Coll.*, Peabody Museum of Natural History, Yale University, **5**, 1936). The members of these subfamilies are largely oceanic and of great interest in structure, habits and distribution. The question as to the relation between structural characters of penæids and their bathymetric habits is discussed and the distributional relations between the oceanic penæid faunas of the Atlantic and Pacific American regions. The larger part of the monograph of 151 pages is morphological, and the species are described and compared in great detail. The *Pawnee* third expedition collected a large number of species, four of which are new, but the descriptions are not confined to these, for there is also material from three co-operative cruises of the research ship *Atlantis*, sponsored jointly by Woods Hole Oceanographic Institution and by Yale University (Bingham Oceanographic Laboratory), and many more species are brought into the discussion dealing with the affinities of the various genera. Useful synopses of their main characters are given. All this very careful work is an important addition to our knowledge of this group of decapod crustaceans.

### New Work on Cœlenterates

PROF. OSKAR CARLGREN has described a very interesting new Lucernariid from South Africa ("Ueber eine neue südafrikanische Lucernariide., *Depastromorpha africana* n.gen. n.sp., nebst bemerkungen über den bau und die systematik dieser tiergruppe". *Kungl. Svenska Vetenskapsakademiens Handlingar*, Tredje Serien. **15**, No. 1; 1935). Besides the detailed anatomical description of *Depastromorpha*, the author has added a comparison of all known genera belonging to the Lucernariidæ with special reference to the musculature, and a table showing the relationships. This cœlenterate family occurs chiefly in northern and southern parts of the world, especially in the Arctic and Antarctic. Until 1933, only antarctic and sub-antarctic forms were known in the southern part of the Atlantic and Indian Oceans. In 1933, Dr. Carlgren described a *Lipkea* from the coast of South Africa, and in 1935 Prof. T. A. Stephenson discovered in Kapstadt the species which is the subject of the above paper. Mrs. L. M. I. Macfadyen (Miss L. M. I. Dean) has described the Stolonifera, Alcyonacea, Telestacea and Gorgonacea of the Great Barrier Reef Expedition 1928–29 (Scientific Reports, **5**, No. 2, British Museum (Natural History), 1936). The collection is a fine one, 51 species being described, of which 6 are new. The order Stolonifera includes several genera whose systematic position has caused discussion. Although agreeing with Prof. Hickson as to most of these, the author is of the opinion that *Solenopodium*, placed by him in the Stolonifera, is really a Gorgonacean. The reasons given are that it appears to be impossible to separate *Briareum* from *Solenopodium* as the spiculation is almost indistinguishable, and *Solenopodium* approaches towards the *Briareum* type of growth. It does not always show a creeping form of growth, but hollow stems grow upwards which are sometimes solid at the tops, forming as it were the beginning of a solid axis.

### Brittle Stars from Puerto Rica

MR. H. CLARK has described four new species of brittle stars from the Puerto Rican Deep out of the collections made by the First Johnson-Smithsonian Deep-Sea Expedition (*Smithson. Misc. Coll.*, **91**, No. 24. Johnson Fund. 1936). Among the numerous species obtained there are three new species of the genus *Ophiomusium*, two of which are interesting in having the upper of the two arm spines transformed into a hook curving outwards from the arm. There are eighteen specimens of *Ophiomusium regulare* n.sp., but only one each of the other two, *O. rosaceum* n.sp. and *O. alecto* n.sp. There is also a new species of *Ophiocira*, a genus of the family Ophiolucidæ, known heretofore only from the Philippine and Lesser Sunda Islands, from 220 fathoms.

### Molluscs and Blood Flukes

ONE of the most widespread of the blood flukes infesting man is *Schistosoma japonicum*. Millions of the inhabitants of China, large numbers in Japan and smaller numbers in Formosa and the Philippines suffer from it. The intermediate host of this, as of many flukes, is a fresh-water mollusc. In spite of the considerable amount of work on the parasite and its relation to the primary host, little has been done on the intermediate host. Bartsch (*Smithsonian Miscell. Coll.*, **95**, No. 5; 1936) has performed a useful piece

of work by reviewing very fully the known molluscan hosts. A number of them is fully described, and they are shown to belong to at least four distinct genera. A series of good keys is provided, which should be of assistance to future workers.

### Self-Sterility in *Eruca sativa* Mill

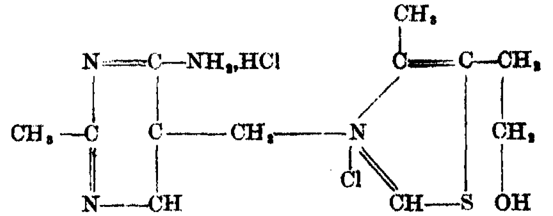
THIS crop plant of the Punjab is highly self-sterile and is normally cross-pollinated by insect visits to the recently opened flowers. Mr. Z. Alam (*J. Genetics*, 32, No. 2) has made a genetical investigation of the self-sterility. Selfing reduces the length of pods by about one-third and the number of seeds to 2–3 per cent of that obtained from crossing. Plants raised from selfed seeds are weakly, shorter with fewer branches and pods, and give a lower yield of seed. Six plants were intercrossed in all possible ways. The results showed the existence of partially self-fertile as well as self-sterile plants. Some cross-matings were fairly sterile, and some compatible matings gave a much higher fertility than others. From bud pollinations it is concluded that a substance inhibiting pollen-tube growth is present in the style at anthesis, but is absent two days before and has gradually disappeared about two days after anthesis. Parthenocarpy and phenospermy were also observed in these experiments. The cause of different degrees of cross-fertility requires further investigation.

### A Reagent for Structure Determination

IN the identification of organic compounds, those tests are especially valuable which can be carried out quickly on small amounts of material and show, by the formation of a colour or precipitate, the presence of a specific group or structure. R. Connor and J. H. Van Campen (*J. Amer. Chem. Soc.*, 58, 1131; 1936) describe a test which, under specified conditions, is general for substances which contain hydrogen on a carbon atom bearing at least one acyl group or two other activating groups. The test consists in adding an alcoholic solution of mercuric chloride to a solution of the unknown in alcohol containing sodium ethoxide. The formation of a white (occasionally cream coloured) precipitate is a positive test. The negative test is the formation of a deep yellow precipitate similar to that obtained when the sodium ethoxide and mercuric chloride solutions are mixed in the absence of an additional reactant. More than two hundred organic compounds have been tested with the reagent, and it appears that it is desirable to limit its use to neutral compounds which do not contain elements other than carbon, hydrogen and oxygen. The classes of compounds with which the test will be concerned will include ketones, aldehydes, esters, hydrocarbons, ethers, acetals, alcohols, quinones and anhydrides. Of these, the last five types fail to give a positive test. Aldehydes and ketones with hydrogen on the carbon atom bearing the carbonyl group give a positive test. The only esters which give a positive test are those which have both hydrogen and a labilizing group on the carbon atom bearing the carboxyl group. Acetylenes appear to give a positive test, and are the only hydrocarbons to do so.

### Synthesis of Vitamin $B_1$

IN June last (*J. Amer. Chem. Soc.*, 58, 1063; 1936), Prof. Williams, of Columbia University, proposed a revised formula for vitamin $B_1$, in which 2.5-diethyl-6-aminopyrimidine is linked through the 5-methyl group to the nitrogen atom of 4-methyl-5-β-hydroxyethyltriazole. According to this view, the vitamin is the hydrochloride of a quaternary nitrogen base:



The Columbia University workers have now, according to a more recent communication from Prof. Williams to the same journal (loc. cit., 58, 1504; 1936), isolated both the bromide and the chloride of a substance having the above formula, and have proved its chemical and physiological identity with the natural compound. The difficulties of their task may be imagined from the fact that the pyrimidine derivative was prepared by five stages from ethyl formate, acetamidine, $NH_2.C(CH_3):NH$, and γ-ethoxyethylacetate, $C_2H_5OCH_2.CH_2.COOC_2H_5$. This was then combined with the substituted thiazole, and the resultant bromide as well as the chloride prepared from it were compared with the corresponding substances from yeast. The thiazole compound appears to be prepared by six stages from ethyl aceto-acetate, β-bromethyl ether and thioformamide. Prof. Williams promises fuller details in forthcoming publications.

### Dayload Peaks in Electrical Engineering Supply

IN the early days of electricity supply, it was soon realized that the machinery that had to be provided depended on the maximum (peak) load of the station. The higher the peak for a given load, the higher the price that had to be charged to the consumer. When direct current was used it was the custom to have a large battery of accumulators, which at times of light load were charged by the dynamos, and when the heavy load came they helped the dynamos by taking part of the load. Thus the load was equalized throughout the day. With alternating current supply it is more difficult to provide reserved power. In an article on "Dayload Peaks" published in the *Electrical Times* of August 13, it is stated that the time at which the peak load occurs is now in the process of changing from the evening to the morning. This is causing anxiety to those supply engineers who take a bulk supply, as their previous estimates will be upset and difficulties may arise. The following factors govern the times and nature of the daily peak load. One factor varies with the class of the load, which depends on the district, another on the time of the year, and a third on the weather. It has been noticed, for example, that the peak load occurs on a certain day at 5 p.m. A few days later, the weather being cold and foggy, it occurs at 9 a.m. This was due to the heating load from fires together with extra shop and domestic lighting. Except in large cities, there seems during the last two or three years to be a definite tendency for the maximum load to occur at breakfast time. If electric water heaters are used, and there is a large demand for hot water before breakfast, this in itself would be sufficient to cause a morning peak on the station load.

# Twenty-five Years of Botanical Progress

THE Brooklyn Botanic Garden had the felicitous idea of marking the twenty-fifth anniversary of its foundation in part by the presentation and subsequent publication of a series of addresses dealing with progress in this period of time in different fields of botanical science. The series of addresses appears in vol. 4 of the *Memoirs* of the Garden (May 7, 1936), and will interest botanical readers everywhere.

The addresses were commendably brief, with the result that the most significant aspects in each field are usually thrown into prominent relief. Thus, Prof. C. E. Allen, dealing with cytology, after a brief reference to cytoplasmic structures, centrosomes and cell-wall, has a very penetrating analysis of the chief features of interest in chromosome studies in the twenty-five year period.

This pairs very well with Dr. Blakeslee's equally interesting review of the progress of genetics. Dr. Blakeslee finds that he is provided with about 0·7 seconds in which to discuss the twenty-five years work of each single geneticist, which produces the surmise that the so-called 'leaders of science' are rather 'pushed' than leading. "It is not the conspicuous spray which erodes the coastline of our continent but masses of water which surge forward with united front". Dr. Blakeslee regards us as passing, in 1910, from the Mendelism and 3 : 1 ratio period to that of "Brass Tacks—Genes and Chromosomes". The significance of three techniques are emphasized in this latter period; the aceto-carmine method which has enabled the rapid study of the nuclei of large numbers of specimens, the production of mutation by radiation treatment and the analysis of chromosomal structure permitted by the salivary glands of fly larvæ.

Dr. Blakeslee decides that the last twenty-five years have brought us again to the species problem, and appropriately enough a contribution follows by Dr. Elmer D. Merrill, director of the New York Botanical Garden, who deals most temperately and justly with the species problem as seen by the experienced taxonomist.

Many other points of view are discussed in this entertaining volume; virus diseases are passed in review, the progress of ecological investigation, of forest administration and research, etc. In short, it is made clear that in the last twenty-five years progress in botany has passed beyond the grasp of any one individual. Let us hope that the result will be to make us all as reasonable in our demands as specialists as Dr. Merrill, who concludes that it is neither necessary nor desirable that all botanists should master the field of systematic botany. "Yet it can be maintained as a general truth that the individual investigator, no matter what his field, who has a reasonable knowledge of the names and relationships of the organisms with which he deals, is a better equipped individual for productive work within his own field, and that the teacher of botany who has the same knowledge is a better teacher".

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# Geology in Great Britain

PART 1 of the "Summary of Progress of the Geological Survey of Great Britain" for 1933[1] contains the usual annual reports of the Geological Survey Board and of the director and gives particulars of routine work carried out during the year under review. As in the succeeding year, there was some slowing down of normal activities on account of the immense amount of additional work involved in preparation for the transfer of the collections to the new museum at South Kensington. Nevertheless, thirty-nine maps were issued, together with five memoirs, which, with one exception, have already been noticed in our columns (NATURE, 134, 782; 1934); the remaining one, the Merthyr Tydfil memoir[7], is reviewed below.

The old Museum of Practical Geology in Jermyn Street closed its doors to the public at the end of 1933. Sir John Flett contributes an interesting outline of its history from its opening in the year of the Great Exhibition of 1851 (see also NATURE, 134, 129; 1934).

Part 2[2] contains a series of papers on subjects of special interest. M. Macgregor and J. Pringle discuss the Scottish Millstone Grit in relation to that of the Pennines. The freshwater fauna of the Lower Coal Measures of Lancashire is described and the range of variation of its constituents demonstrated by W. B. Wright. The corresponding fauna in West Yorkshire is dealt with by D. A. Wray and A. E. Trueman. A valuable synopsis of Coal Measure plants and their stratigraphical distribution is provided by R. Crookall. The results of a study of the Carboniferous rocks of Innimore Bay, Morvern, on the Sound of Mull, are recorded by M. Macgregor and W. Manson. The fossils of certain pebbles in the Peel Sandstones of the Isle of Man are shown by H. P. Lewis to be of Salopian age. W. Manson describes the Carboniferous and Old Red Sandstone strata passed through by a boring for water (340 ft. deep) at Stonefold Farm, Berwickshire, with petrographical notes by J. Phemister. Sir John Flett continues his investigations of the teschenite-picrite sills of the Lothians with a study of a thomsonized inclusion from the Blackness sill.

Part 1 of the "Summary" for 1934[3], in addition to the usual information, records the transfer of offices, library and collections from Jermyn Street to South Kensington. The opening of the new Museum in July 1935 was recorded, with an account of the centenary celebrations, in NATURE (136, 75; 1935). Despite the strenuous activity necessitated by the change-over, and the employment of the equivalent of about one third of the field staff in the preparation of exhibits, all the normal departments of the Survey's work were carried on without

serious interruption. Maps issued during 1934 number forty-one, and there were published two memoirs, both of which are reviewed below (Ardnamurchan model[5] and Fife Coalfields, Area II[8]). Certain features of the year's work deserve special notice. The colour-printed maps include twelve of the London area on the six-inch scale; fifteen further sheets of the same series were in the press by the end of the year. Among new maps in progress, mention may be made of a series of economic maps of England and Wales on the scale of 16 miles to the inch. Two of the sheets, devoted respectively to the coalfields (exposed and concealed) and iron ores have since appeared. These indicate that the series is likely to be of great educational value, and teachers, in particular, should not overlook this authoritative guide to mineral resources. The most important innovation of the year, however, was the preparation of a series of eighteen descriptive handbooks under the general title of "British Regional Geology". Eleven of the handbooks have now been published and a separate account dealing with them will appear shortly in these columns.

In Part 2[4], Prof. J. de Lapparent (Strasbourg) contributes a most important study of the Carboniferous bauxitic clays of Ayrshire. These deposits contain boehmite and diaspore and it is shown that the conditions of their formation involved the hydrolyzing action of a tropical climate followed by subsidence and burial. It is noted that bauxites which remained exposed during their formation contain gibbsite. W. Edwards describes the Pleistocene dreikanter of the Vale of York, and points out that conditions suitable for such wind-faceting were widespread in Britain and Europe towards the close of the Pleistocene. The strata encountered in a boring (810 ft.) in Northamptonshire are described by B. Smith, the special interest being the discovery of an old floor of presumably Pre-Cambrian quartz-felsite beneath the Keuper Marl. Another boring (980 ft.) at Bushey, Herts, reached Devonian rocks beneath the Gault. The strata are described by F. H. Edmunds; the Palæozoic fossils by C. J. Stubblefield; and the underground water by F. K. Sinclair. One of the most widespread of the fossil-bands of the North-West Province of the Lower Carboniferous is that characterized by *Cyrtina septosa*. It has now been discovered in the Midland Province of Derbyshire and is the subject of a paper by F. W. Cope. Palæontological contributions include a critical examination by K. P. Oakley of a Wenlock coral which has been referred to the Polyzoa by certain authors; a description of a Downtonian eurypterid from Lanarkshire by Dr. L. Størmer (Oslo); notes by C. J. Stubblefield on types and figured specimens acquired from the late S. S. Buckman by the Survey; and an account by W. B. Wright of the large species of *Carbonicola* which characterize the base of the Middle Coal Measures.

The "Guide to the Geological Model of Ardnamurchan"[5] refers to a model, originally constructed for exhibition in the Royal Scottish Museum, which displays the complicated solid geology of the worn-down and long extinct volcano of Ardnamurchan. The horizontal scale is four inches to a mile, but as the highest peak, Ben Hiant, reaches only 1,729 ft., heights have been slightly accentuated by adopting a vertical scale of six inches to a mile. The guide is very fully illustrated and forms a readable introduction to the remarkably interesting features of a Tertiary volcano which is justly famous for the perfection of its ring-structures and the variety and significance of its petrological phenomena. A detailed memoir on the area was published in 1930 (see NATURE, 128, 619; 1931).

The volume descriptive of the underground water supplies of Herefordshire[6] is one of a growing series which now covers the London area and twenty-eight counties. The usefulness and practical value of these memoirs has been especially emphasized by the droughts of recent years. As Herefordshire is a county that depends to a very considerable extent on underground resources for its potable water—whether as feeders of bores, wells and springs, or as contributors to the flow of rivers during dry periods—this latest issue should prove especially welcome. The main rivers are also discussed as sources of supply, and a selection of chemical analyses of the river- and well-waters suffices to show the principal types of water available.

The first edition of the memoir dealing with the Merthyr Tydfil district of the South Wales Coalfield was published in 1904 and has been out of print for many years. The progress of mining and geological research has made necessary a considerable amount of revision in the new edition[7], particularly as regards the zoning of the Carboniferous rocks and the underground structure and correlation of the coal seams. The district includes a large part of the magnificent mountain range of the Fforest Fawr, the highest peaks of which, the Brecknock Beacons, lie just north of the area described. Bare cliffs and numerous river channels clearly display the higher strata of the Old Red Sandstone, together with the Carboniferous Limestone and Millstone Grit formations. The southern part of the region is in Coal Measures and includes the industrial centres of Merthyr, Aberdare and the upper part of the Swansea valley. Special chapters are devoted to economic minerals and to palæobotany.

The second of the series of memoirs describing the economic geology of the Fife coalfields[8] deals with the central part of the county, comprising an area of about a hundred square miles, mainly occupied by strata of Lower Carboniferous age. The structure is complicated by numerous faults and intrusions of igneous rock, while the sequence in the southern part includes considerable thicknesses of lavas and ashes. The main structural feature is the Burntisland anticline, which separates the Cowdenbeath and Lochgelly coalfields on the west from the Kirkaldy coalfield on the east. More than 1,400 bore and shaft records have been collected to elucidate the relations of the formations. Much of the memoir is devoted to the coal-bearing strata of the Limestone Coal Group and the Productive Coal Measures.

The memoir describing the geology of the Orkneys[9] will be generally welcomed because the official survey has only recently been completed and is of special interest on account of the wealth of new information regarding the Old Red Sandstone now made available. The first four chapters deal with the history of geological research, the topography and scenery, and the general geology of the islands which make up the group. The intermediate chapters provide more detailed accounts of the individual districts and islands, while the last three chapters are respectively concerned with fossil fishes, fossil plants and petrography. With the exception of a small area in the neighbourhood of Stromness, where an ancient granite-schist complex occurs, most of the islands are mainly built of flagstones and sandstones belonging

to the Middle division of the Old Red Sandstone. These beds were folded and heavily eroded before the deposition of those of the Upper division. The latter are restricted to Hoy and include ashy sediments and olivine-basalt. Five volcanic vents have also been detected in Hoy. The structure of the island-group is comparatively simple, consisting essentially of a central series of synclines passing over on the west into the broad and gentle West Mainland anticline and on the east into a series of minor anticlines. Faulting follows three directions, two of which are represented by the shores of Scapa Flow, where three important faults all throw down towards the sea. Numerous dykes of bostonite, camptonite and monchiquite traverse the Old Red Sandstone, but their age, as elsewhere in Scotland where similar dykes occur, is still undetermined. The memoir is provided with a bibliography, a glossary of Orkney place-names, and an excellent geological map in colour on the scale of 4 miles to one inch.

[1] "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1933". Part 1. Pp. viii+93. 1*s*. 6*d*. net.

[2] *ibid.*, Part 2. Pp. viii+108+8 plates. 3*s*. net.

[3] *ibid.*, for the year 1934. Part 1. Pp. viii+85. 1*s*. 6*d*. net.

[4] *ibid.* Part 2. Pp. viii+65+4 plates. 1*s*. 6*d*. net.

[5] Guide to the Geological Model of Ardnamurchan. By J. E. Richey. Pp. 49+9 plates. 1*s*. net.

[6] Wells and Springs of Herefordshire. By L. Richardson. Pp. viii+136+2 plates. 3*s*. net.

[7] The Geology of the South Wales Coalfield. Part V. Merthyr Tydfil. By A. Strahan, W. Gibson and T. C. Cantrill. Second edition. By T. Robertson; with a Palaeobotanical Chapter by R. Crookall. Pp. xix+283+6 plates. 5*s*. 6*d*. net.

[8] Economic Geology of the Fife Coalfields. Area II. (Cowdenbeath and Central Fife). By J. K. Allan and J. Knox. Pp. xi+207+2 plates. 4*s*. net.

[9] The Geology of the Orkneys. By G. V. Wilson and W. Edwards, R. C. B. Jones, J. Knox and J. V. Stephens; with Chapters on Fossil Fishes by D. M. S. Watson; Fossil Plants by W. H. Lang; and Petrography by J. S. Flett. Pp. xii+205+8 plates+a Geological Map (4 miles to 1 inch) in folder. 5*s*. net.

(London: H.M. Stationery Office.

## Educational Topics and Events

THE following scholarships for 1936 have recently been awarded by the Institution of Electrical Engineers: *Ferranti Scholarship* to W. E. Harper (University of Birmingham); *Duddell Scholarship* to P. Hargreaves (Lower School of John Lyon, Harrow); *Silvanus Thompson Scholarship* to L. S. Anand (North-Western Railway, India); *Swan Memorial Scholarship* to D. H. Thomas (Metropolitan-Vickers Electrical Co.); *David Hughes Scholarship* to W. H. Penley (University of Liverpool); *Salomons Scholarship* to E. F. O. Masters (City and Guilds College); *Thorrowgood Scholarship* to L. G. Leaton (Southern Railway Co.).

ARMSTRONG COLLEGE, Newcastle-upon-Tyne, has a Standing Committee for Research which distributed in 1934–35 grants amounting to £891. Its annual report, recently published, includes a series of informative notes by the recipients of these grants, which were in most cases for purchase of apparatus or material. The lion's share (23 out of 25) went to research in the natural sciences. One, made in connexion with a visit to the Massachusetts Institute of Technology for spectroscopic work, contributed to the establishment of valuable personal contacts with scientific workers in the United States. The visit included attendance at a conference on spectroscopy, an account of which was read before the British Association. Another grant was used largely in the purchase of Irish parliamentary reports for a study of "British Imperial Policy in the Twentieth Century", which provokes the question: is it not 'up to' Governments, seeing that they stand to benefit from the products of competent disinterested research in the social sciences, to encourage it to the extent, at least, of placing such material gratuitously at the disposal of an investigator of the standing of a university professor of history.

THE Department of Business Administration at the London School of Economics, established a few years ago on the initiative of a group of business men for university men who were resolved on a business career, has had another successful year. An Advisory Council has recently been established to assist in maintaining the closest possible touch between training and current practice. The chairman of the Council is Major-General Guy P. Dawnay, and its membership includes Sir Harold Bellman, Sir Kenneth Lee, Sir Felix Pole, Sir Frank Spickernell and others who are prominent in different fields of finance, industry and trade and who are united in the determination to develop the Department as a centre of business training for graduates of British universities. Interest in the post-graduate course of business training extends beyond those industries represented on the Council, and an American business man has recently given £200 for a studentship for 1936–37 in the fields of investment or finance. The Leverhulme studentship of £200 is also open to competition. Some business firms have from time to time used the Department as a kind of staff college, and others have offered appointments to graduates subject to their first attending satisfactorily the Department's course. Great care is taken to admit to the course only those likely to make good in a business career. There is now apparent a demand among managers themselves for lectures on current problems, and in the winter months of 1936–37 a series of twelve such public lectures will be delivered by six members of the academic staff on matters of administrative organization, business finance, industrial production, distribution developments, marketing and public relations, statistical and accounting service.

A STUDY of education in Czechoslovakia was undertaken by the United States Office of Education two years ago. A report prepared by a specialist in comparative education, S. K. Turosienski, on the basis of visits paid to a great number of types of schools as well as interviews with school authorities and examination of official documents, has been published as Bulletin No. 11 of 1935 (Washington: Government Printing Office, 25 cents). The establishment of a national system of public education was one of the first tasks confronting President Masaryk after the new Republic of Czechoslovakia was constituted in November 1918. The report indicates that the system is working well and contributing powerfully to the prosperity and well-being of the nation. Problems arising from multilingualism—Czechoslovak, Carpatho-Russian, German, Magyar, Polish, Rumanian, modern Hebrew and other tongues are used as languages of instruction—have been solved with remarkable success. Religion is a compulsory subject of study in all elementary, secondary and normal schools, the time allotted for it being, in general, two hours a week. Particular care is taken to exclude influences calculated to inflame racial or national animosity. In all secondary and elementary schools instruction is given in civics,

under the headings: national culture, League of Nations, civilization of all nations, general progress of mankind, equality among the races and nationalities, the World Court, international treaties and guarantees, international pacifism, religious tolerance, history of labour and civilization, natural laws, man and the world, conditions of happy, peaceful life, etc. Parental co-operation with the school authorities is legally provided for by means of parents' councils. A noteworthy feature of the system is the clarity with which the objectives of education are set forth, not merely with reference to the educational process as a whole but also specifically for each course.

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## Science News a Century Ago

### Death of Dr. William Henry, F.R.S.

On September 2, 1836, Dr. William Henry, the eminent chemist, died at Manchester at the age of sixty-two years. The son of Thomas Henry (1734–1816), one of the founders and the first secretary of the Manchester Literary and Philosophical Society, he was born at Manchester on December 12, 1774, and attended the Manchester Grammar School. For several years he was secretary and assistant to Dr. Thomas Percival (1740–1804), the first president of the Literary and Philosophical Society, but, when twenty-one years of age, spent a session at the University of Edinburgh, where he was one of the last pupils of Black. On his return to Manchester, Henry assisted his father in his chemical business, wrote memoirs and lectured, and in 1801 published his "Epitome of Chemistry", which was enlarged and became "The Elements of Experimental Chemistry". It was said that this was the first English work on chemistry which with considerable literary merit combined scientific accuracy. It went through eleven editions. His experiments on the absorption of gases by water were made while he was writing these books. In 1805 he returned to Edinburgh, and two years later was granted the degree of M.D. The remainder of his life was spent in Manchester, where he counted among his friends Dalton.

Henry was elected fellow of the Royal Society in 1808, and in the same year received the Copley Medal. His original contributions to science included papers on medical subjects such as diabetes and cholera, and biographical sketches of Priestley, Davy and Wollaston. At intervals during his life he suffered severely from an accident received when a child, and his death on September 2, 1836, was due to nervous irritation and insomnia. He was a refined, eloquent and accomplished man, and his bust and portrait are preserved by the Manchester Literary and Philosophical Society of which he was an ardent supporter. His life was written by his son, Dr. W. C. Henry.

### The British Association at Bristol

Summarizing the results of the Bristol meeting of the British Association, the *Athenæum* of September 3, 1836, said: "Having now read the Reports; and calmly and dispassionately surveyed the entire proceedings, we are of opinion, that the results of the Bristol Meeting are most satisfactory: rather more than 1,300 members were present, many of the papers read were very valuable, many important questions were discussed, and the Committee have been enabled to devote no less than £2,700, in further aid of science and scientific research. These are beneficial effects not to be questioned. It appears, however, that the Association does not work to the entire satisfaction of some influential members . . . who . . . are of opinion, that some proceedings in particular Sections had a taint of quackery . . . and they are in consequence disposed to limit the sphere of inquiry, or restrict the numbers. Now, we concur generally as to the possible tendency of the Association; such an opportunity for personal display and cheap advertisement will not be lost by the far-seeing; but the remedy suggested would be, in our opinion, a still more mischievous error. There can be no such thing as an oligarchy of science, which these *restrictions* would tend to create. We take leave to suggest the most scrupulous care in the election of Chairmen to the several Sections . . . and a great deal more energy and resolution on the part of the Sectional Committee; the one (the Committee) should be foreseeing and directing, and the other (the Chairman) the controlling mind of the Association. . . ."

### Botanical Society of London

On September 3, 1836, the *Mechanics' Magazine* said: "A number of botanists, amateurs, etc., have recently held several meetings at the Crown and Anchor Tavern, Strand, for the purpose of forming themselves into a society bearing the above name. . . . Among the leading objects the Society propose are, the advancement of botanical science in general; the particular cultivation of descriptive and systematic botany; the formation of a library, herbarium and museum; the reading of original papers, extracts and translations; the exchange of specimens with other societies or individual collectors; and every other available means that may promote the object of the Society". Commenting on this, the journal said: "We are glad to find, among the mighty mass of bricks and mortar, ladies and gentlemen so ardently devoted to so healthy and so enduring a pursuit as botany".

### The Flora of Ireland

In 1836 appeared the "Flora Hibernica: comprising the Flowering Plants, Ferns, etc., of Ireland; arranged according to the Natural System", by J. T. Mackay, who from 1806 until 1862 was curator of the Botanical Garden, Trinity College, Dublin. In a notice of the book in the *Athenæum* of September 3, 1836, a reviewer said: "We congratulate our Irish friends upon the publication of this work. It is most creditable to the naturalists of Ireland that the first general account of the plants of the island should appear in a form corresponding to the actual state of science elsewhere. . . ."

"The character of the classes and orders are taken chiefly from the writings of De Candolle and Lindley; and the arrangement employed by the last-mentioned botanist, in his 'Synopsis of the British Flora' is followed, with few exceptions. The character of the genera and species are chiefly from Hooker's 'British Flora'; for the matter relating to Mosses, Hepaticæ, and Lichens, the author is indebted to Dr. Taylor, and for the arrangement of the Algæ to Mr. W. H. Harvey, both of whom are naturalists well known for their acquaintance with those difficult groups."

# Societies and Academies

## Paris

**Academy of Sciences, July 6 (*C.R.*, 203, pp. 1–136)*.**

JACQUES ERRERA, POL MOLLET and MLLE. MARY L. SHERRILL: Tetramethylethylene and the influence of the double bond. Study of the infra-red spectrum.

VICTOR HENRI: The electronic state of the radicals in polyatomic molecules. The radicals discussed are SO, CN, C=C, NN, and NO. The results relating to the electronic states of the radicals, based on infra-red and Raman spectra, and on the determination of the distance between the atoms of the radicals measured by X-rays or electron rays, can serve as a basis for the analysis of the mechanism of chemical reactions between these molecules. They lead to a new interpretation of the laws of chemical kinetics.

MAURICE BACHELET: The extraction of uranium *X* by precipitation of ferric hydroxide. The exact working conditions are given: the yields vary from 85 to 95 per cent.

MAURICE E. NAHMIAS and ROBERT J. WALEN: Some artificial radio-elements. Results of the bombardment of fluorine and sodium by neutrons.

HANS VON HALBAN, JUN. and PIERRE PREISWERK: Experimental proof of the diffraction of neutrons.

GEORGES CARPÉNI: The dissociation constants of ascorbic acid and of its product of oxidation by iodine.

ALEXANDRE KRASSILCHIK: The use of the uranyl-magnesium reagent in dilute alcohol. Discussion of the errors inherent in this method of determining sodium, and suggestions for their elimination.

MLLE. JEANNE FORET: The synthesis of hydrated mono-calcium silicates under pressure.

TRYPHON KARANTASSIS and LÉANDRE CAPATOS: The hexa-iodotellurates of the aromatic amines and of the heterocyclic bases.

ADRIEN PERRET and JOSEPH BIECHLER: Researches on some chlorocarbonates.

MLLE. JEANNE BOULANGER: Study of the systems zirconyl oxalate, alkaline oxalates and water.

PIERRE SÜE: The thermal equilibrium between $Nb_2O_5$, $Na_2CO_3$, $CO_2$.

GEORGES DUPONT and RAYMOND DULOU: The oxidation of cyclohexene by hydrogen peroxide.

JULES GARRIDO: The dehydration of brucite.

JEAN WYART and YEU KI-HENG: The crystallographic study of some derivatives of tartaric acid. X-ray studies of tartramide, tartramic acid, methyl tartrate and potassium borotartrate.

PIERRE MARIE: The Cretaceous micro-fauna of the south-east of the Paris basin.

MARCEL ROUBAULT: The radioactivity of some natural springs of the Kabylie de Collo (Department of Constantine, Algeria).

CHARLES BOIS: Earthquakes with abnormally deep focus. A table showing focal depth obtained by various authors by different methods.

PAUL CORSIN: The phylogeny of the Inversicatenales.

PAUL BERTRAND: Some fundamental observations for the comprehension of the organization of vascular plants.

ROGER HEIM: The phylogeny of the Lactario-Russula.

MLLE. JANE MANUEL: The sexuality of *Hansenula Saturnus* and of some species of the genus *Saccharomyces*.

* *Continued from p.* 338.

MARCELL MASCRÉ and RENÉ RAYMOND-PARIS: The comparative action of acrolein vapour on the cellular structure and glucidic composition of some plant tissues.

ANTOINE DE CUGNAC: The experimental production of inter-specific hybrids in the genus *Bromus*, and some related systematic considerations.

DÉSIRÉ LEROUX: The influence of the trituration of cultivated soils on the amount of essential fertilizing principles in their aqueous extract.

ROBERT CASTAGNÉ: The improvement of technique [historadiography]. Substitution of a window of lithium for one of aluminium. Lower voltages can be used and exposures shortened.

EMILE HAAS: Comparison between the energy of a simple radiation and that of a mixture of radiations of the same visual appearance.

CHARLES LAPICQUE: The optical structure of the vitreous body.

R. JONNARD: The interferential study of the refraction of blood serum as a function of the concentration.

STIG VEIBEL and ERIK NIELSEN: A case of a non-hydrolyzable β-glucoside.

JEAN ROCHE and MLLE. MARIE THÉRÈSE BÉNEVENT: The hæmatins of the α-cytochromes.

THÉOPHILE CAHN and JACQUES HOUGET: The utilization of glucides in experimental diabetes.

GASTON RAMON and ANDRÉ STAUB: A new method of anthrax vaccination.

## Moscow

**Academy of Sciences (*C.R.*, 2, No. 1, 1936).**

S. MICHLIN: Composition of double integrals.

L. KANTOROVICH: Some theorems on semi-regular spaces of general type.

B. DEMIDOVICH: Existence of an integral invariant in a complex of periodic points.

P. A. WALTHER and V. A. STEFANOVSKIJ: Action of centrifugal forces inside the axial pump.

A. A. GRÜNBERG and B. V. PTICYN: Titration of bivalent platinum and trivalent iridium at different temperatures.

J. G. RYSS and N. P. BAKINA: Complex fluorides. (1) Hydrolysis of the silicofluoride ion.

W. A. SILBERMINZ and A. K. RUSANOV: Occurrence of beryllium in fossil coals.

G. M. SMIRNOV and G. M. ZARIDZE: Neo-intrusions of the Dzyrul crystalline massif.

A. M. LEBEDEV and L. I. SERGEJEV: Regeneration of vernalized plants after injury of the growing points.

I. N. KONOVALOV: The effect of the vernalization of plants upon the accumulation of organic substance.

S. V. DOROFEJEV: Observations on the reproduction period of Greenland seals (*Histriophoca*) (*groenlandica oceanica* Lepechin).

A. S. SEREBROVSKIJ: An attempt at a new method of genetical analysis of quantitative characters.

**(*C.R.*, 2, No. 2, 1936).**

P. S. ALEXANDROFF: Contribution to the theory of topological space.

B. Z. VULICH: Some remarks to the theory of *K*-normed space.

V. RASUMUVSKIJ: Latent polarity and explicit polarity of molecules.

L. W. NIKITIN: Acoustico-electrochemical phenomena (2).

I. N. NAZAROV: Metal-ketyls of the fatty series. (4) Action of metallic sodium on *tert.*-butyl-*tert.*-amyl and *tert.*-butyl-*tert.*-hexyl ketones.

T. N. GODNEV and S. V. KALISHEVICH: Quantitative determination of chlorophyll with the aid of the light of a Lange electrical colorimeter.

P. G. DANILCHENKO: Ecology of the spawning migrations of the salmon.

## Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 327–434, June 15).

FREDERICK H. SEARES: Selective absorption of starlight by interstellar clouds. Measures of the colours of certain stars in luminous or dark nebulosities show them to be redder than would be expected from their spectral types. This seems to be due to selective absorption of light, and quantitatively it is sufficient to require a radical change in the estimated dimensions of the stellar system.

CECILIA PAYNE GAPOSCHKIN: On the physical condition of the super-novæ. Their spectra are similar to those of ordinary novæ, but with wider bright lines. It is concluded that they differ from novæ mainly in size, having possibly developed from giant stars.

E. S. CASTLE: A model imitating the origin of spiral wall structure in certain plant cells. Six wooden dowels are fixed in a wooden base and their free ends separated by a small wooden spool. A ring pushed down over the dowels produces a spirally twisted formation, which seems to be similar to that of the wall of the spore-bearing cells of Phycomyces.

NATHANIEL LYON GARDNER: A new red alga from New Zealand. It is parasitic on *Zostera* and has two forms, one having erect filaments (*Erythrocladia Hunteriæ*).

N. L. BOWEN and J. F. SCHAIRER: The system albite – fayalite. The mixture is heated in a crucible suspended in a platinum resistance furnace, and the temperature of appearance of a phase is determined by quenching the charge in mercury and examining it under the petrographic microscope to determine the phases present. The diagram for albite – fayalite is of simple eutectic type. It is hoped to use the marked fluxing action of albite to examine the equilibrium relations of other silicate mixtures.

M. DEMEREC: Frequency of 'cell-lethals' among lethals obtained at random in the $X$-chromosome of *Drosophila melanogaster*.

ALEŠ HRDLIČKA: Puberty in Eskimo girls. The age of onset for 16 full-blooded Kuskokwim Eskimos (Alaska) and also of 6 mixed-bloods is 13¾ years, which is unexpectedly low for so far north.

FROELICH G. RAINEY: Eskimo chronology. A test cut to a depth of fourteen feet through a stratified midden deposit at Kukulik, St. Lawrence Island, Alaska, has revealed six cultural horizons, most of which have been recognized at widespread Eskimo sites in the Arctic.

WILLIAM HOVGAARD: Torsion of rectangular tubes. Current theory, based on a hydrodynamical analogy, represents the angle of torsion correctly up to the point of breakdown, but gives an incorrect picture of the stress distribution.

R. COURANT: (1) On the problem of Plateau. (2) On the theory of conformal mapping.

G. A. MILLER: Regular subgroups of a transitive substitution group.

HANS LEWY: Generalized integrals and differential equations.

J. W. ALEXANDER: On the connectivity ring of a bicompact space (2).

*(To be continued.)*

## Forthcoming Events

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, August 29.—Annual General Meeting to be held at Newcastle-upon-Tyne.

## Official Publications Received

### Great Britain and Ireland

Survey of Thunderstorms in the British Islands. British Thunderstorms, continuing Summer Thunderstorms. Fourth Annual Report, 1934. (Vol. 2, Part 1.) By S. Morris Bower and others. Pp. iv+48+4 plates. (Huddersfield: Thunderstorm Census Organisation.) 2*s*. 6*d*. [48

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report (Twenty-third Year) 1935, East Malling Research Station, East Malling, Kent, 1st January 1935 to 31st December 1935. (A. 19.) Pp. 242+10 plates. Free to Associate Members; to non-Members, 4*s*. Supplementary Annual Report (Twenty-third Year). General Development and Activities, East Malling Research Station, East Malling, Kent, 1st January 1935 to 31st December 1935. (Miscellaneous Publication H. 26.) Pp. 22. (East Malling: East Malling Research Station.) [48

*Prospectus of the University College of Wales, Aberystwyth.* Sixty-fifth Session, 1936–1937. Pp. 128. (Aberystwyth: University College of Wales.) [78

### Other Countries

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau Central de Magnétisme Terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 14. (Pp. ii+102. (Paris: Les Presses universitaires de France.) [78

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 8 (Items 2842–2941): October, November, December, 1935. By Ernest A. Hodgson. Pp. 157–178. 25 cents. No. 9 (Items 2942–3041): January, February, March, 1936. By Ernest A. Hodgson. Pp. 179–194. 25 cents. (Ottawa: King's Printer.) [78

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 140: The Nature of the Deflection-Aileron Flutter of a Wing as revealed through its Vibrational Frequencies. By Katsutada Sezawa and Satosi Kubo. Pp. 301–338+plates 4–7. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 50 sen. [108

*Koninklijk Nederlandsch Meteorologisch Instituut. No. 102, Mededeelingen en Verhandelinge,* 38: De gemiddelde hoogtewind boven De Bilt volgens loodsballonwaarnemingen. Door W. Bleeker. Pp. v+126. ('s-Gravenhage: Rijksuitgeverij.) 1.10 fl. [108

Proceedings of the First Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India, held at Delhi from the 25th February to the 2nd March 1935; with Appendices. Pp. v+377. (Delhi: Manager of Publications.) 6 rupees; 9*s*. 9*d*. [108

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 87, 1935. Pp. iii+572+17 plates. (Philadelphia: Academy of Natural Sciences.) 6.25 dollars. [108

The Indian Central Cotton Committee. Spotted Boll-Worms in South Gujarat. Pp. 24. (Bombay: Indian Central Cotton Committee.) [108

Indian Forest Records (New Series). Vol. 1, No. 3: Results obtained with a Timber Drying Kiln heated directly by Furnace Gases (Helmpel and Besler's Double Firing Generator Kiln). By Dr. S. N. Kapur. Pp. iii+77–92+2 plates. 10 annas; 1*s*. Vol. 2, No. 2: Standard and Commercial Volume Tables for *Dalbergia sissoo*. By M. A. Kakazai. Pp. iv+47–58+3 plates. 8 annas; 10*d*. (Delhi: Manager of Publications.) [108

Memoirs of the India Meteorological Department. Vol. 26, Part 5: Soundings of Temperature and Humidity in the Field of a Tropical Cyclone and a Discussion of its Structure. By Dr. K. R. Ramanathan. Pp. 79–92+8 plates. (Delhi: Manager of Publications.) 1.6 rupees; 2*s*. 3*d*. [108

*Jahresbericht der Hamburger Sternwarte in Bergedorf für das Jahr 1935.* Erstattet von dem Direktor Dr. R. Schorr. Pp. 25+4 plates. Astronomische Abhandlungen der Hamburger Sternwarte in Bergedorf. Band 4, Nr. 8: Untersuchungen über die Methode der effektiven Wellenlängen. Von Marius Lobsien. Pp. 201–212. (Bergedorf: Hamburger Sternwarte.) [108

U.S. Treasury Department: Public Health Service. Variations in *Physique and Growth of Children in Different Geographic Regions* of the United States. Physical Measurement Studies, No. 2. By Carroll E. Palmer and Selwyn D. Collins. (Reprint No. 1677 from the Public Health Reports.) Pp. 13. 5 cents. Height and Weight of Children of the Depression Poor. Health and Depression Studies, No. 2. By Dr. Carroll E. Palmer. (Reprint No. 1701 from the Public Health Reports.) Pp. 7. 5 cents. Changes in the Incidence and Fatality of Smallpox in Recent Decades. By Dr. A. W. Hedrich. (Reprint No. 1738 from the Public Health Reports.) Pp. 30. 5 cents. (Washington, D.C.: Government Printing Office.) [108

Hamburger Sternwarte in Bergedorf. Bergedorfer Eigenbewegungs-Lexikon für die in der Bonner Durchmusterung, der Cordoba Durchmusterung und der Cape Photographic Durchmusterung, enthaltenen Sterne des nördlichen und südlichen Himmels. 2 Ausgabe. Unter Mitwirkung von Dr. W. Kruse und B. Imgart. Herausgegeben von Prof. Dr. Richard Schorr. Band 1: Nördlicher Sternhimmel. Pp. viii+410. Band 2: Südlicher Sternhimmel. Pp. viii+232. (Bergedorf: Hamburger Sternwarte.) [108

The Academy of Natural Sciences of Philadelphia. Annual Review, 124th Year, 1935. Pp. 16. (Philadelphia: Academy of Natural Sciences of Philadelphia.) [118

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No. 3488 SATURDAY, SEPTEMBER 5, 1936 Vol. 138

# Food Requirements in the Modern State

THE Health Committee of the League of Nations has given abundant evidence during the past few years of its interest in human nutrition. The health experts who were asked last year to formulate guiding principles for the construction of adequate human diets emphasized the importance of the provision of ample supplies of protective foods, especially dairy produce, fresh vegetables and fruit, for the purpose of securing an optimum state of nutrition. The problem of securing such supplies for the masses of the populations of modern States must involve in most instances far-reaching changes in economic and agricultural policies. A mixed committee was accordingly set up, composed of economic and agricultural experts, in addition to health experts, under the chairmanship of the Viscount Astor, to report on the whole position regarding the relation of nutrition to health, from the point of view of practical politics. The Committee has now issued the first volume of its report*, which provides a general survey of the problem.

In the light of the established principles of nutrition, it can be shown that in no country does the whole population attain the scientifically desirable standard of physical development or resistance to disease. To remedy this serious defect, the greatest emphasis ought to be laid on the proper feeding of pregnant women and of children, for many individuals bear throughout life the stigmata of defective feeding in childhood. This would involve a campaign of education in which public health officials, practitioners of medicine, health nurses, school teachers and social workers should co-operate. Economic and agricultural policies would have to be framed by the Governments concerned, to enable the necessary food to be produced and distributed. The campaign for better nutrition should take its place as an integral part of national policy. Such a policy would require for its effective working the supervision of a central authority which would secure the co-operation of bodies engaged in nutritional research, of those engaged in popular instruction and of those responsible for directing economic and agricultural policies.

The main body of the report deals in simple language with the dietary requirements of human beings of different classes and age-groups, and gives illustrations of some of the observed effects of improper feeding on the physique and health of individuals and communities. This section is followed by chapters dealing with some of the economic and agricultural aspects of the problem of nutrition. These chapters are short, for the reason that later volumes of the report will deal more fully with these particular aspects.

In the last section of the present volume, the Committee formulates recommendations which it invites the Assembly of the League of Nations to approve, in the hope that they may be accepted by Governments and may make an immediate contribution towards the improvement of nutrition among the peoples concerned. These recommendations urge the policy of encouraging the scientific study of nutritional problems and of furthering the dissemination of knowledge so gained. International co-operation is invited to facilitate the exchange of relevant information. Governments are also urged to consider what steps might be taken to meet the nutritional requirements of those

* The Problem of Nutrition. Vol. 1. Interim Report of the Mixed Committee on the Problem of Nutrition. (London: Allen and Unwin (League of Nations Publications Dept.), 1936.) 2s.

sections of their communities with the lower ranges of income, and particularly to ensure an adequate supply of safe milk for expectant and nursing mothers, infants, children and adolescents. Further recommendations include the examination of schemes to make supplies of the protective foods available at prices within the reach of all classes without prejudicing the interests of producers. If necessary, the question of the re-orientation of agricultural production, with the view of satisfying the requirements of sound nutrition, should be seriously considered.

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# Malaria and Nutrition

THE Royal Society, more than thirty-five years ago, followed up Ross's discovery of the mosquito-cycle of the malaria parasite by sending specially qualified research workers to Africa and India to study the endemiology and epidemiology of the disease and the life-history and habits of the mosquitoes which transmit it. Judged by the results of those investigations, which were published as Reports to the Malaria Committee of the Society between 1899 and 1903, the action was one of the most important steps ever taken for the advancement of knowledge of the subject. The Society has recently taken a second step which everyone will hope may have an equally important outcome. At a meeting held in July this year, the Council decided that the whole income, together with the invested income, of its Medical Research (Anonymous) Fund should be employed for a period of five years on a scheme of laboratory research on malaria to be conducted in England, and a field inquiry into malnutrition to be conducted in India. The two subjects are more closely related than may be apparent, for it has been shown repeatedly in Italy and elsewhere that measures designed to improve the nourishment and general welfare of the people have a great effect in lessening the mortality, disability, and other evils due to acute or chronic malarial infection.

The scheme as a whole is estimated to cost about £8,500 for the period mentioned, and has been worked out and arranged for in detail. The malaria programme is in two parts, of which the first is concerned with the parasites and their relationship with human, animal and insect hosts, the second with the ecology of one or more of the species of anopheline mosquitoes chiefly responsible for spreading malaria in the tropics. On both subjects an advanced type of scientific 'long-range' research by modern experimental methods is contemplated. It is believed that in the present state of knowledge this highly specialized type of work offers the best hope of improving existing methods of dealing with malaria, and it is recognized that its pursuit has been facilitated during recent years by several outstanding events such as the application of the practice of malariatherapy to the study of malaria itself, as well as for its original purpose, and the discovery that monkeys, as well as canaries and other birds, can be utilized for studying immunological and other problems. It is intended, too, to give increased attention to the chemotherapy of malaria, which has become of paramount importance since the discovery of effective synthetic anti-malarial remedies, and is a subject on which, up to the present, little has been done in Great Britain (see NATURE, Nov. 9, 1935, p. 743).

The practical object of the proposed research into the ecology of a particular species of anopheline mosquito is to improve the antimalarial method called 'species sanitation', which aims at the elimination from an area of the species that has been found to be most concerned in transmitting the disease. Success in this task would be greatly facilitated if complete knowledge were available of the biology, habits and behaviour of the insect concerned, and particularly if the physical, chemical and other factors governing its choice of breeding places, food supply, shelter and other items of behaviour were precisely known. Thanks to new methods devised by insect physiologists, these problems can now be studied experimentally in the laboratory and applied to observations made in the field.

Lieut.-Col. J. A. Sinton, I.M.S., lately director of the Malaria Survey of India, has been appointed to conduct the first part of the malaria programme, and it has been arranged that he will work in the laboratories of the Malariatherapy Centre at Horton where, in addition to the intensive study of particular problems, he will have an opportunity of continuing and extending the observations on

induced malaria which it was feared might have to be given up when Colonel S. P. James retires this year.

The second part of the programme is to be commenced in the Entomological Department of the London School of Hygiene and Tropical Medicine by the appointment of a young worker with experience in modern experimental zoology. For a period of 12–18 months he will study the physiology and behaviour of the several species of anopheline mosquitoes which can be made available in England, and will then proceed to an appropriate centre in India for the special research proposed. It is understood that the London School has undertaken to meet part of the cost of this research.

Dr. Curjel Wilson has been appointed to conduct the nutritional survey in India in collaboration with Dr. Aykroyd, director of nutrition research to the Indian Research Fund Association. The survey will be concerned chiefly with the incidence of malnutrition among school children, and the dietary habits of groups of families in the districts where the children live. An important object of the investigation will be to train workers who will continue and extend the survey.

It may confidently be expected that the expenditure from its trust funds by the Royal Society which this programme involves will be fully justified by the additions it will make to our knowledge of malaria, which, despite all that has been done during the last three decades, still remains the greatest single destroyer of the human race.

# Nature and Purpose of Science

**The Scientist in Action:** a Scientific Study of his Methods. By Dr. William H. George. Pp. 355. (London: Williams and Norgate, Ltd., 1936.) 10*s*. 6*d*. net.

THE reviewer's first task is to state the nature of the book and the purpose of its author. Here this task is very difficult. "Action" is the key-word of the title; and on his first page, Dr. George tells us that he takes it "as basic that scientific research is a form of human action". But he has just said that "by definition speaking, writing or manipulation . . . are forms of action but thinking, believing or feeling are not." Research then, for Dr. George, is an activity in which thought and belief play no part. This is sufficiently puzzling; but it becomes more puzzling when most of the book is found to be concerned with things that are indubitably thought or believed and not *done*—laws, theories, propositions in general, and so forth.

This inconsistency pervades the book. A possible (but of course speculative) explanation is suggested by hints in the final section. It is that Dr. George started to "clarify his mind on the relation between experiment and theory, and more especially on the relation between experimental and mathematical physics"—in other words, to solve the central problem of the philosophy of science. Reading the works of his forerunners, he was repelled (as many others have been) by the folly of those to seek to interpret science as a set of formal propositions out of any relation to the scientists who produce them. He therefore rushed to the other extreme and, "to his own surprise", arrived at the conclusion that science, though "inseparable from scientists, is quite separate from philosophy". In order to understand science, all that is necessary is to study the scientist reacting, like any other organism, to its environment; his problem turned out to be purely biological.

Of course, Dr. George could not act consistently on such a belief. Mental activity is even more difficult than physical activity to describe without some preconceived scheme to which it is supposed to conform; and even if a perfectly neutral description of the mental activity of a scientist could be given, it would not explain that activity or clarify anyone's mind concerning it. For that task it is necessary to show that the activity does conform to some logical scheme that is equally valid for all kinds of thought; the ordering of different kinds of thought into a single coherent whole is not merely inseparable from philosophy; it actually is philosophy. Accordingly, Dr. George found himself alternating between his new desire to ignore all forms of activity that cannot be merely described, and his old desire to clarify his mind; his book is a queer medley of his two moods.

Dr. George's work in his old mood does not appear to me very valuable. He has made the common mistake of being so preoccupied with those at the opposite extreme of thought as to ignore altogether those who stand very near to his own point of view. Thus, he might have been expected to find Bridgman's "operational"

doctrines sympathetic; he makes no reference, explicit or implicit, to Bridgman, but expresses approval of Hobson, who really agrees with him in nothing but a common dislike of transcendental metaphysics.

The book is divided into three main sections: the scientific outlook, getting scientific facts, arranging scientific facts. What Dr. George has to say on the topics to be expected under these headings is neither very original nor very profound; it is difficult to summarize, because so much of it is merely negative. Science is *not* based upon measurement; the "coincidence observations", constituting the facts on which it is based, are *not* merely temporal or spatial; the observables of quantum theory are *not* what is actually observed; mathematical probability is *not* a measure of rational belief. But the positive assertions that might be expected to supplement these negations are lacking; after the last of them "the reader is left to decide" what, if any, is the connexion between probability and belief—surely a matter vital to any understanding of science!

In his new mood, however, Dr. George is a very different person. His description of scientific activities is always accurate and, though there are many commonplaces, often acute. He does not, of course, profess to instruct researchers in their art, but few of them could read the book without gaining some useful hints; at any rate they will be soothed and entertained by finding all their instinctive prejudices set forth so sympathetically.

However—this may possibly shock Dr. George—the persons who will gain most from his work are precisely the philosophers whom he treats with such contempt. For many of them accept fully Dr. George's main thesis that science is incomprehensible apart from scientists. But they find it difficult to discover how scientists really think. Lack of technical knowledge forbids them to study the original literature of science; while those distinguished men who undertake to explain science to the unlearned are notoriously untypical; indeed their success as popularizers is largely due to their sympathy with views that most scientists reject emphatically. Their difficulty is now completely solved. Dr. George is a thoroughly typical scientist—typical, not of all scientists (that is impossible, because scientists differ), but of those to whose mental idiosyncrasy the distinctive character of science is due; and he has been marvellously successful in portraying their method of thought.

Accordingly, if anyone in the future writes about the nature and purpose of science, meaning thereby that which scientists produce, without careful study of Dr. George's book, he will be wasting his own and his reader's time. But of course he will find himself in a difficulty. For what distinguishes the true scientist is a hatred of abstract thought and of the shackles of logic. The discovery of an intellectual difficulty delights the philosopher; it makes Dr. George and the rest of us go all hot and bothered. If this dislike of logical precision is a necessary element of the scientific outlook, there can be no philosophy of science; if a scientist who was willing and able to untie the intellectual knots in which he is constantly entangling himself, would thereby cease to be a scientist, then there can be no place for science in any scheme of ordered thought. If, on the other hand, this attitude is unnecessary and inessential, if science is really subject to a logic which alone can make it intelligible, how do scientists manage to produce science? The great merit of Dr. George's book lies in its raising this problem so clearly; it is for others to solve it.

NORMAN R. CAMPBELL.

# The People of Pitcairn Island

**The Heritage of the Bounty:**
the Story of Pitcairn through Six Generations. By Harry L. Shapiro. Pp. xv+330+8 plates. (New York: Simon and Schuster, Inc.; London: Victor Gollancz, Ltd., 1936.) 3 dollars; 10*s.* 6*d.* net.

PERENNIAL interest in the story of Bligh and the mutineers of the *Bounty* has been enhanced recently by the cinematograph; but Dr. Shapiro, though fully alive to the drama of the story, of which he recalls the main outlines, is more immediately concerned with the opportunity afforded science by the consequences of this tragedy of the sea. While still *in statu pupillari*, he was inspired by Prof. E. A. Hooton of Harvard with an overwhelming urge to biological and sociological investigation among the descendants of the mutineers and Tahitian women living on Pitcairn Island. He had to wait twelve years before his desire was satisfied. Although he visited Norfolk Island in 1923, and spent five months examining the Pitcairn Islanders and their descendants who had been transported there in 1856—the results were published in 1929—it was not until 1934 that he was able to land on Pitcairn.

Pitcairn Island, it will be realized, offers exceptional opportunity for the study of miscegenation and the effects of culture contact. The islanders are the descendants of six mutineers and thirteen Tahitian women. The six Tahitian males left no offspring. Although the descendants of the migrants to Norfolk Island are the more numerous, conditions on Pitcairn are more favourable to scientific investigation, as the accessions of new blood there have been few and are known—eight Europeans and one Polynesian female. The records of birth, marriage and death have been kept with care, while genealogical data are remembered with pride—and no less well remembered when calling for a veil of reticence. Another advantage from the point of view of the observer is that the material is entirely unaffected by the social disabilities which usually depress the products of racial crossing elsewhere and vitiate observation.

It is a remarkable fact, perhaps the most striking fact in the vital statistics of the island, that the increase in population has been extraordinarily rapid. In one hundred and forty-five years from the original matings, the living descendants of the mutineers now pass the eight hundred mark. There are more than six hundred living on Norfolk Island and some two hundred on Pitcairn; and if absentees were taken into account, the figure might well fall not far short of a thousand. The early generations seem to have been extraordinarily prolific. A calculation by Dr. Shapiro gives in his second group of women, listed according to years of birth in the period 1815–39, an average family of 11·2. It was owing to this rapid increase in numbers, which threatened over-population, that the Pitcairn Islanders were transported to Norfolk Island in 1856. Of those transported, forty-two had returned to Pitcairn by 1864; and from them the present population is descended. The continued rapid increase in numbers during the last seventy years is thought by the islanders again to threaten over-population; but Dr. Shapiro is of the opinion that the danger is not imminent. His analysis shows that the rate of increase is falling with a falling birth-rate.

Although inbreeding naturally is intense, no ill effect is perceptible, except possibly deterioration in the teeth. It may be responsible for a degree of homogeneity in physical character unusual in such a population of mixed origin.

The evidence of cross strains in physical character is interesting. The two stocks were markedly differentiated, and the strains on both sides certainly not inferior. The English probably were picked men. While the men of the present day incline to favour their European ancestry, as, for example, in the tendency to a lighter coloured eye, the women favour the Tahitian. In them the dominant in eye colour is brown. In skin colour there is an overlap with both English and Tahitian. While none is as dark as the darker Tahitian, few individuals are as fair as the fairest English. In stature the men are taller than either the Tahitian or their European ancestors, of whom the height is recorded at the Admiralty. The head-length is almost identical with that of the Tahitian, being less than that of the English head; but in breadth they follow the English measurement and are narrower than the Tahitian. The cephalic index is intermediate between the two. It is interesting to note that the characteristic disproportion between the frontal diameter and broad face found in the Tahitian appears also in Pitcairn, although the facial breadth is low as in the English. Consequently in the Pitcairn islander the frontal diameter is lower than in the Tahitian, and still more so than in the European.

Dr. Shapiro sums up his results as showing that in their heredity the Pitcairn Islanders bear testimony to both their English and their Tahitian ancestry; and while some are more influenced by the Tahitian strain, some by the English, others appear to be intermediate. Each one is a varying mixture of characters, of which some follow the Tahitian, others the English character. On the whole, the features of the islanders are definitely English. This preponderance is only natural, the author concludes, as all new additions to the colony have been of English stock. Fortunately, the researches in the Pitcairn records made by Dr. Shapiro, which are here embodied with material from outside sources in a history of the islanders from the time of the first settlement, enable all such additions to the original strains to be traced and checked.

It is interesting to note that the author is decidedly of the opinion that the results of his investigation support the view that an early result of miscegenation is an increase of vigour transcending that of either of the original stocks.

Dr. Shapiro has recorded a number of phrases of the Pitcairn language, which he regards as a hybrid dialect. His evidence scarcely bears this out; and a closer knowledge of colloquial English tradition might have convinced him that it does not attain even the dignity of a dialect. It seems to be a mispronounced and degenerate English with a few Tahitian words and mannerisms.

The present-day culture is a blend which shows evidences of development, when compared with that recorded by early visitors to the island. The absence of European materials and appliances in the beginning naturally has affected the balance between English and Tahitian.

Dr. Shapiro is to be congratulated on the opportunity for this first scientific study of unique material, and on the use of it which he has made.

# Some British Cœlomycetes

**British Stem- and Leaf-Fungi (Coelomycetes):** a Contribution to our Knowledge of the Fungi Imperfecti belonging to the Sphaeropsidales and the Melanconiales. By W. B. Grove. Vol. 1: Sphaeropsidales, to the end of the Sphaerioideae which have Colourless or nearly Colourless Spores. Pp. xx+488. (Cambridge: At the University Press, 1935.) 21*s.* net.

In this handbook, Mr. Grove monographs the recorded British species of this most obscure group of the fungi, a task that has not been attempted in Great Britain since 1871. His Cœlomycetes comprise the Sphaeropsidales and Melanconiales sections of the Fungi Imperfecti, most, if not nearly all, of which are no doubt Ascomycetes classified in their imperfect as opposed to their perfect condition.

The modern systematic mycology of this group really dates from vol. 3 of Saccardo's "Sylloge Fungorum", which appeared in 1884. It is perhaps impossible for us at this date to envisage the state of affairs before Saccardo collected together all the recorded nominal species and put them upon his mycological map, but we may properly recall the cheer with which Mr. Grove greeted the appearance of this volume. In the *Midland Naturalist*, 9, 127 (1886), he tells us how, as about to vault a fence, he observed myriads of black specks on the bark of the top pole; how he deduced in the field that the pole must be mountain ash; how at home the black specks resolved themselves into the pycnidia of *Rhabdospora* as judged by their spores and habitat; and how he turned "to that monument of Herculean labour, the Sylloge Fungorum omnium of Professor Saccardo . . . who stands head and shoulders above all the other mycologists of the age". *Rhabdospora inaequalis*, Sacc., it was, for it agreed in the characteristic pycnidia, the spores and the habitat, and as further evidence there was Saccardo's excellent representation. "Now my task is smoothly done. No link in the chain is wanting. We have determined our fungus with a degree of certainty that cannot always be attained, and are still further rewarded by finding that it is a species new to Britain".

Some forty-eight years have passed, and Mr. Grove presents us with the first half of his monograph of British Cœlomycetes; and—as a monograph must of course—it contains numerous species that cannot be determined with the same certainty that marked the recognition of *Rhabdospora inaequalis*. In Cooke's "Handbook", two hundred species were recorded as British; in this and the second volume which is shortly to follow, more than two thousand nominal species are listed. All the included species have been examined microscopically unless the contrary is specified, the material, on which this work is based, being represented by the collections at Kew and the British Museum, and by more than three thousand collections in the author's private herbarium. At long last, we have a good general idea of what has been found in Great Britain, together with what a most experienced naturalist has made of it.

Mycology is a term that is now held to cover many pursuits, but, broadly speaking, fungi can be studied in the field, in herbaria, in laboratories and in books. The work under notice is the result of some fifty years' ardent collecting and examining at home, checking determinations with authentic material, and a wide knowledge of the systematic literature. The laboratory side of the science, which has developed so strongly of late—especially since the Great War—is left to others.

Saccardo's ground plan, laid down in vol. 3 of the "Sylloge", is accepted absolutely, the most important change following on the general recognition of the genus *Phomopsis*, to which a large number of nominal species have in recent years been transferred. It does not appear that any other course was open to anyone who intended to present an orderly account of British Cœlomycetes, and surely it is high time that such an account should be presented. This classification—and it is the only one yet devised—is largely a habitat classification; that is to say, Cœlomycetes which fruit on leaves are apt to find themselves in another genus from those that fruit on stems; pycnidia formed on the surface of wood are not normally classified in the same genus as those that develop just beneath the periderm. As is well known, fungi in pure culture are apt to present little resemblance to their appearance in their natural habitat—the appearance under which they have been discerned, collected, described, classified and preserved in herbaria. It is, therefore, much safer to attempt the identification of a Cœlomycete, in the first instance, before, rather than after, isolation. If this elementary precaution is not taken, there is no known method of ensuring that any systematic data that may be acquired will be comparable to the data preserved in the existing diagnoses of fungi. Such, at any rate, is Mr. Grove's message

to the culture men, whom, after a characteristic implement of their craft, he dubs the "petripetallists".

Together with the ground plan, the author accepts Saccardo's usage of generic names, and will have no nomenclatorial grit thrown into the works, especially by the new type species method of fixing genera (he gives no type species for the genera). As examples, see his citation of the genus *Phoma*, and his inclusion of *Hendersonia elegans* Berk., the type species of *Hendersonia*, in the genus *Stagonospora*, with a footnote that it will probably prove to be neither a *Hendersonia* nor a *Stagonospora*.

As with genera, so with the view of specific values, current for so many years after the appearance of the "Sylloge", but in this case with a note of hesitation. "Generally, in these pages, the host will be made the supreme test" but "in the genera *Cytospora*, *Phomopsis*, *Septoria* and the like, the list of presumed species cannot be considered as anything but an interim catalogue of the known and described forms". It is probably on this question of specific distinction that systematically directed culture work could be of the most immediate use to a study of the Cœlomycetes. For example, a *Phomopsis* is usually, if not always, the pycnidial condition of a species of the ascomycete genus *Diaporthe*. Mr. Grove lists about 158 nominal British species of *Phomopsis*. In a recent world monograph of *Diaporthe*, Wehmeyer has suggested that the type species, *D. eres*, which was first described on *Ulmus*, really occurs upon nearly all woody plants, and has (ominously enough) acquired about 160 synonyms. The question as to the number of good British species of *Phomopsis* is obviously open for research by anyone who cares to collect, determine and isolate these common and easily grown fungi. Pending any such study, Mr. Grove will probably agree that we are still very much in the position so graphically described by Saccardo, when he was roughing out the classification of the Fungi Imperfecti. "Et in Mycologia fere omnes tyrones sumus."

The citation of literature is terse. The standard floras appear as "All.", "Died." and "Mig.". B. & Br. stands for Berkeley and Broome and B. & V. for Berlese and Voglino. The original place of publication is often not given, especially with Saccardo's own species which later became incorporated in the "Sylloge", vol. 3. The author has been misled into thinking that the dates on the title pages give the correct dates of many species that were founded by Allescher and Diedicke. These, however, are points of nomenclatorial compilation, and the interest of the book is wholly taxonomic; it has, in fact, quite clearly grown out of a lifetime's comparison of the British flora with the diagnoses in a well-thumbed and well-loved copy of vol. 3 of the "Sylloge".

In common with all the foundation mycological books of any country, the present volume has required of its author a knowledge of our local phanerogams in bud, in leaf, in flower, in fruit and in decay—especially in decay. It appears to me that it will be welcomed by all British botanists who believe that the plants themselves, and the fungi themselves, are the thing. It is a milestone in our slow—our very slow—advance in the study of the microfungi. It may happily help to dispossess the commonly copied figures of a few fungi of their predominating influence on the young idea. It may even serve to distract attention from hypothesis and speculation and direct it rather to the original source of mycology itself—the yearly pageant of our woods and fields.

E. W. MASON.

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**Crustacea:**
Anomura, Macrura, Euphausiacea, Isopoda, Amphipoda and Echinodermata: Asteroidea and Echinoidea. By Lee Boone. (Bulletin of the Vanderbilt Marine Museum. Volume 6: Scientific Results of the World Cruise of the Yacht *Alva*, 1931, William K. Vanderbilt commanding.) Pp. 264 + 96 plates. (Huntington, L.I., N.Y.: Vanderbilt Marine Museum, 1935.)

THE present volume relating to Crustacea and Echinodermata collected by Mr. Vanderbilt and deposited in his museum is full of interesting material. Careful descriptions and good figures are given of every form described. The larger crustaceans are already known, but much new matter is added, and among the Caridea there are many new species. These last were mostly taken in coral and include a *Leptochela*, an *Athanas*, *Alpheus* spp., a *Coralliocaris*, a *Thor* and a *Pontophilus*, besides a pontoniid which the author has referred to a new genus which she has named *Vanderbiltia*. Besides all these new species, many little-known forms are redescribed. There are also two new species of *Euphausia*. Some isopods and amphipods are included.

Among the most striking of the Caridea is the pontoniid *Conchodytes biunguiculatus* Paulson, which was found inhabiting the pearl oyster *Meleagrina* sp. Its peculiarly modified hind legs (pereiopods 3–5) end in large hook-like claws, presumably for clinging to its host, and the abdominal terga of the female are very broad, forming a brood pouch, which holds 75–100 young.

The echinoderms must be magnificent, judging from the exquisite photographs, especially the sea-urchins.

**Molekülspektren und ihre Anwendung auf chemische Probleme**

Von Prof. Dr. H. Sponer. 1 : Tabellen. Pp. vi + 154. 17.60 gold marks. Teil 2 : Text. Pp. xii + 506. 37.80 gold marks. (Struktur und Eigenschaften der Materie, Bd. 15, 16.) (Berlin : Julius Springer, 1935–36.)

THERE is a good deal to be said in favour of the manner in which Prof. Sponer has arranged the material which he discusses in these two books. The first is really an appendix or collection of results for use in conjunction with the description of the applications of band spectra to chemical problems in part 2, and consists of a series of tables of the terms of spectra emitted by polyatomic molecules. Similar tables were, of course, given in Jevons's "Report on Band Spectra" for diatomic molecules, but the Sponer collection for more complicated molecular systems is new, and the data for diatomic molecules have been brought up to date. While it appears unlikely that the descriptive matter in the five hundred page Part 2 will soon need serious revision, it should be a relatively easy matter to add fresh results in a new edition of the one hundred and fifty page Part 1.

Part 2 is intended to assist experimenters, and there is little attempt at serious mathematical treatment of the subject. It opens with a brief, but good, introduction to the older quantum theory of spectra and to the new quantum mechanics, and continues with an excellent survey of the several types of band spectra and their peculiarities. The main interest lies in the examination of the methods and results of band spectra measurement and the chemical and physical data which can be obtained from them, and in the discussion of their importance in problems of chemical combination and valency. Considerable attention is paid to the methods by which molecular spectra are excited and to photo-chemical reactions. The book is bound to appeal considerably to chemists and to physicists who are interested in the applications of band spectra.

**Destiny and Disease in Mental Disorders :**
with Special Reference to the Schizophrenic Psychoses. By Prof. C. Macfie Campbell. (Thomas W. Salmon Memorial Lectures.) Pp. 207. (London : Chapman and Hall, Ltd., 1935.) 10*s*. 6*d*. net.

PROF. MACFIE CAMPBELL, who is professor of psychiatry at Harvard University, gives us a very readable account of personalities struggling against the difficulties of their environment, particularly with reference to the schizophrenic psychoses, which are a particular type developing in early adult life. This comes as quite a relief when contrasted with lengthy dissertations on infected bowels and sinuses. We feel on reading all these books on mental disorder that the problem in many ways has not even yet been stated, far less grappled with. There are so many factors involved, and we know so little. The writer, however, points out the importance of the environment and its manifold reaction on personalities, many of which we feel were already psychopathic in build.

**Insect Enemies of Shade-Trees**

By Prof. Glenn W. Herrick. Pp. x + 417. (Ithaca, N.Y. : Comstock Publishing Co., Inc., 1935.) 5 dollars.

THE name of Prof. G. W. Herrick, of Cornell University, as a guarantee for a sound, trustworthy textbook is fully substantiated in the present volume. It brings together much scattered information regarding the insect pests of shade trees east of the Rocky Mountains and most of those on the Pacific coast. The economic values of each species of tree are discussed and the most effective control measures against their chief enemies are dealt with. For the most part, each species of tree, with its insect invaders, forms the subject of a separate chapter while, at the end of the book, pests of the smaller trees and shrubs, and some miscellaneous enemies, are dealt with collectively. In so far as certain of the species of insects mentioned are of European origin, the book will interest English readers, while the control measures advised are often applicable on this side of the Atlantic Ocean. The book is admirably printed with 331 clear text figures, which are mostly original. Considering the excellence of its general 'get up', the book is reasonably priced at five dollars.

**Hydrostatics :**
a Text-Book for the use of First Year Students at the Universities and for the Higher Divisions in Schools. By A. S. Ramsey. Pp. viii + 169. (Cambridge : At the University Press, 1936.) 7*s*. 6*d*.

THIS volume has been specially prepared for the use of first year students in universities and for pupils reading for scholarships in the higher divisions of schools. It is thus a companion volume to the author's books on dynamics and statics, which have been published in recent years. The course well covers the academic requirements in the subject, and includes some simple applications of the metacentre, together with a brief discussion on capillarity. A working knowledge of the calculus is assumed, and there are numerous exercises provided for the student, many of which are taken from Cambridge examination papers. Answers to these are given where necessary. The text is illustrated with clearly drawn diagrams and elegantly worked-out examples. The book is admirably suited to its purpose.

**Outlines of General Psychopathology**

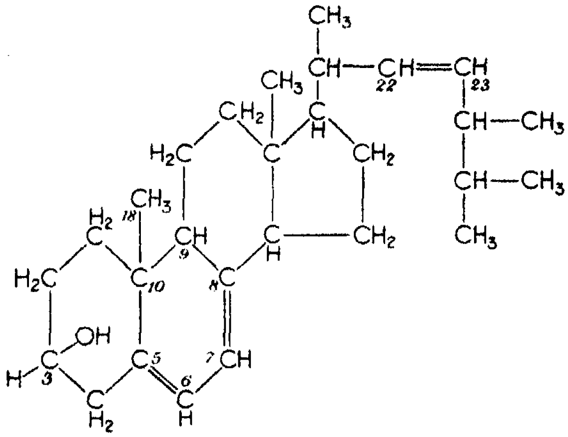
By Prof. William Malamud. Pp. xiv + 462. (London : Chapman and Hall, Ltd., 1935.) 21*s*. net.

PROF. W. MALAMUD, who is professor of psychiatry in the State University of Iowa, gives a very readable and useful account of the principles of general psychopathology. We wish, however, that he had enlarged somewhat on the physiological concomitants : action currents, particularly the Berger rhythm, chronaxie, and the psychogalvanic reflex are all subjects about which the reader will want to know more than the author gives us—a mere page for the three.

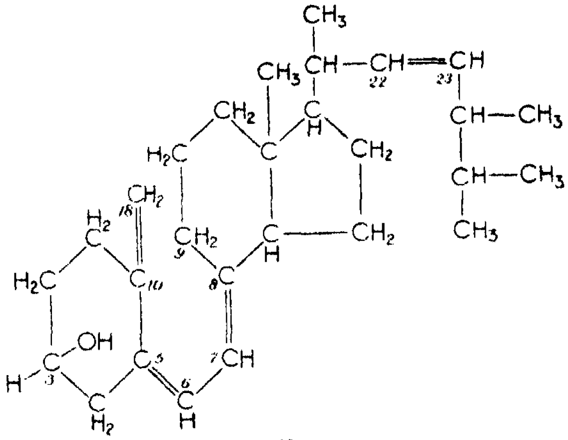
The chapter on the psychopathological disturbances of sleep is very well done.

# Chemistry of Calciferol and Vitamin $D_3$

CALCIFEROL (Windaus's vitamin $D_2$) and ergosterol have, according to the view accepted to-day, the formulæ shown in II and I below, respectively.



I



II

The important common features of the two molecules are:

(*a*) The possession of two conjugated double bonds at $C_5{=}C_6$ and $C_7{=}C_8$.

(*b*) The possession of a hydrocarbon chain containing a double bond at $C_{22}{=}C_{23}$.

The two substances differ in one fundamental respect, namely, the fracture of ring *B* between carbon atoms 10 and 9 and the replacement of the methyl group containing carbon atom 18 by a methylene group, with the consequent introduction of a third conjugated double bond between carbon atoms 10 and 18. It is also possible, indeed probable, that the hydroxyl group at carbon atom 3, which is present in ergosterol—and in all other naturally occurring sterols—in the *trans* position (making the sterols members of the cholestanol series), occupies the *cis* (*epi*) position in calciferol. The point seems not yet to be settled.

A series of papers just published by Windaus and his Göttingen colleagues* is another landmark in vitamin chemistry. They report the logical conclusion, or almost the conclusion, of investigations that have been conducted at Göttingen during the past four or five years.

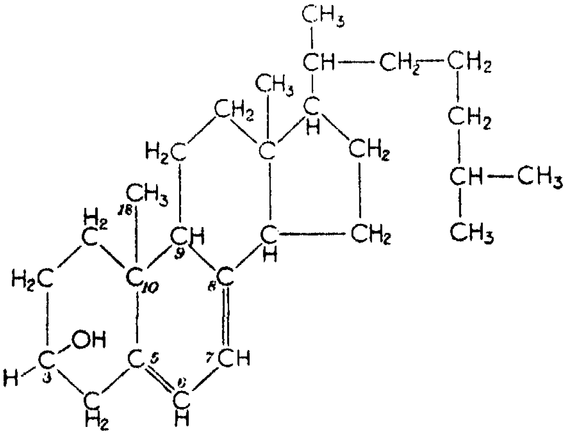
For some time it has been believed, on the basis of differential biological experiments with two species of animals, that the vitamin D of cod-liver oil is not calciferol. (Bills goes further and maintains that at least *two* separate antirachitic substances occur in fish-liver oils, in different proportions according to the species of fish.) Attempts to isolate this substance have so far been unsuccessful, though claims for a very high degree of concentration have been made, notably by Rygh and by Ender.

A crystalline 3,5 dinitrobenzoate of this vitamin, and a colourless non-crystalline preparation of the hydrolytic product from the ester, have now been prepared by Brockmann. The source was tunny-liver oil. The activity of the liquid vitamin is stated to be $25 \times 10^6$ I.U. per gram, but it is not inconceivable that traces of impurity may be responsible for its failure to crystallize, and the pure compound may prove to be more active. The absorption spectrum is very similar to that of calciferol, thus disproving Ender's claims for concentration, since his product showed no bands in the ultra-violet. Brockmann argues that Ender's claims must have been overstated by 900 per cent! In other words, that his preparation cannot have contained as much as 10 per cent of the vitamin and cannot have had more than one tenth of the biological activity claimed by him.

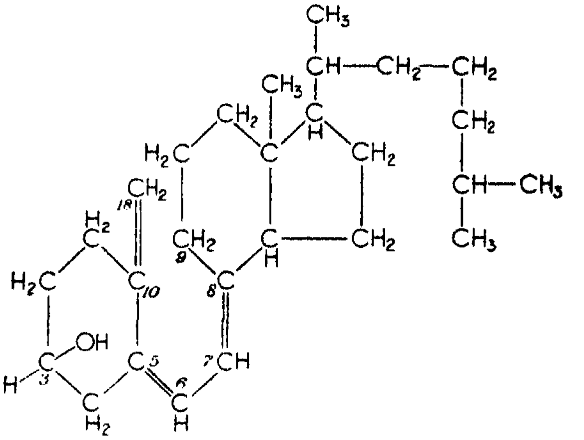
The constitution of this vitamin, for which Brockmann proposes the symbol $D_3$, would not be known but for the brilliant parallel investigations of Windaus, Schenck and Werder, whose results are published alongside Brockmann's. It is now rather more than a year since Windaus, Lettré and Schenck announced the preparation of 7-dehydro-cholesterol ($\Delta^{5:6,7:8}$ cholestadien-3-ol) and stated that it could be made antirachitic by irradiation. They have now isolated the crystalline 3,5 dinitrobenzoate of the active irradiation product, as well as its colourless

* *Hoppe-Seyler's Zeitschrift für physiologische Chemie*, **241**, 100, 104, 116, 125, 129 (1936).

non-crystalline hydrolytic product. Both appear to be in every respect identical with the corresponding substances prepared from tunny-liver oil. It would therefore seem almost beyond doubt that, since 7-dehydro-cholesterol has formula III, the tunny-liver vitamin must be constituted as shown in IV.



III



IV

There is, in fact, a replacement by an ethyl group of one hydrogen atom on carbon atom $C_{24}$ in the side-chain of cholesterol. From the above data it would appear as if the $C_{22}{=}C_{23}$ double bond in calciferol were responsible for its exceptionally potent effect on rachitic rats, compared with that on chickens, and this is borne out by the fact that

If this formula correctly represents the constitution of vitamin $D_3$, it differs from calciferol only in the absence of the double bond at the side-chain position $C_{22}{=}C_{23}$, and the replacement of the terminal side-chain group $—CH(CH_3)—CH(CH_3)_2$ in calciferol by $—CH_2—CH(CH_3)_2$ in vitamin $D_3$. The physiological differences between the two vitamins must be determined by the differences in the two side-chains which are shown here alongside.

$—CH(CH_3)—CH{=}CH—CH(CH_3)—CH(CH_3)_2$
Calciferol

$—CH(CH_3)—CH_2—CH_2—CH_2—CH(CH_3)_2$
Vitamin $D_3$

This is in itself a quite remarkable finding, but it becomes a mystery when we consider two further investigations reported simultaneously with those summarized above. Wünderlich has prepared 7-dehydrositosterol and irradiated it. The crude irradiation product appears to have only about one fortieth of the antirachitic potency found in irradiated ergosterol, produced presumably under identical conditions. It is not, however, legitimate to argue that the isolated vitamin will have one fortieth the activity of calciferol, since the relative amounts in the two crude irradiation products may be different. If, however, the general course of the photochemical changes is identical, then the vitamin from dehydrositosterol must differ from calciferol and vitamin $D_3$ only in the structure of the side-chain, which is

$—CH(CH_3)—CH_2—CH_2—CH(C_2H_5)—CH(CH_3)_2$
(Sitosterol)

the irradiation product of 22-dihydroergosterol has been reported by Windaus and Langer as having only one thirtieth the activity of irradiated ergosterol. Here again, however, it must be emphasized that crude irradiation products, not distinct crystalline compounds, were being compared. The low activity of irradiated 7-dehydrositosterol may, therefore, be due either to the absence of the $C_{22}{=}C_{23}$ double bond, or to the extra carbon atoms in the side-chain, or to both.

The greatest puzzle, however, arises from a study of 7-dehydrostigmasterol, prepared and irradiated by Linsert. The side-chain of stigmasterol, and therefore presumably of 7-dehydrostigmasterol and its active irradiation product, is

$—CH(CH_3)—CH{=}CH—CH(C_2H_5)—CH(CH_3)_2$
(Stigmasterol)

Here we have the $C_{22}{=}C_{23}$ double bond associated with the activity of calciferol, and the simple replacement of the ergosterol methyl group at $C_{24}$ by an ethyl group. According to Linsert, the irradiation product of 7-dehydrostigmasterol is "überraschenderweise" nearly or entirely without *any antirachitic action!* Yet *it is chemically*, to all appearances, much more akin to calciferol than any of the other products discussed in this article. Moreover, if 22-dihydroergosterol gives an irradiation product that is very active, though markedly less so than ergosterol, it is inexplicable that 22-dihydro-7-dehydrostigmasterol, which is in fact 7-dehydrositosterol, should give a *more* antirachitic irradiation product than the stigmasterol derivative.

The facts relating the side-chain constitution to the antirachitic properties of their irradiation product can be summarized thus:

| Sterol | Carbon atoms in side chain | Double bond in side chain | Antirachitic potency |
|---|---|---|---|
| Dehydrocholesterol | 8 | 0 | ++++ |
| Ergosterol | 9 | 1 | ++++ |
| Dihydroergosterol | 9 | 0 | +++ |
| Dehydrostigmasterol | 10 | 1 | ? |
| Dihydrodehydrostigmasterol (Dehydrositosterol) | 10 | 0 | + |

It has been suggested by Schoenheimer that the number of carbon atoms in the side-chain has a profound effect on the absorbability of sterols. If this be so, and if it apply also to the irradiation products, the explanation of the facts cited may be found along these lines. Difficulty in accepting such an explanation, however, arises from the fact that ergosterol shows, like sitosterol and other plant sterols, poor absorbability, while cholesterol is very well absorbed, yet the irradiation product of ergosterol is apparently absorbed as easily as that of dehydrocholesterol.

The various papers here summarized are supplemented in the same journal by a very interesting account, from Brockmann and Chen, of an antimony trichloride colour-test for both vitamin $D_3$ and calciferol. The authors claim a considerable degree of specificity for the test, and it will doubtless be eagerly tried by many workers in this field.

A. L. BACHARACH.

# British Regional Geology

IN the new Museum of the Geological Survey at South Kensington the exhibition of British geology has been arranged on the basis of a division of the country into eighteen districts, each of which forms a geological and geographical province of distinctive type. To each region a separate division of the main floor or first gallery has been assigned, and in order to render the exhibits more intelligible descriptive handbooks have been prepared to serve as guides. These handbooks, issued under the general title of "British Regional Geology", also serve as compendious summaries of local geology. Eleven have already been published and these are briefly noticed below.

The Survey is to be warmly congratulated on the success of this important new enterprise. Each handbook is beautifully illustrated with maps, diagrams and plates, and the descriptive matter adequately provides all the necessary detail for a general comprehension of the area concerned. The complete series will constitute the most authoritative and attractive account of British geology as a whole which has ever appeared; one, indeed, that will be indispensable to students for purposes of general study. The individual numbers, issued at the remarkably low price of 1*s*. 6*d*. each, serve as welcome introductions to the more specialized sheet memoirs, and also as guides to tourists and others who wish to appreciate the interest and significance of the geological features of any British district.

"London and Thames Valley"[1] embraces a region from Oxfordshire and north Wilts to Essex and north Kent. It thus comprises beds ranging in age from Lias to Pleistocene and Recent, the main features being the Chalk escarpment of the Chiltern Hills and its continuation west of the Goring Gap, and the middle of the London Basin. Palæozoic formations are known from numerous borings, most of the rocks bearing a general resemblance to those of the Welsh Borders. As in most of the other handbooks of the series, an excellent list of maps and memoirs and a selected bibliography of other publications dealing with the district are appended.

The handbook on "The Wealden District"[2] covers the area to the south of the above and is probably one of the most familiar geological regions in the world. The Weald proper is continued across the Straits of Dover into the Bas Boulonnais. Beds of many ages are concealed beneath the covering of surface rocks, and at the eastern end of the Weald every system of older stratified rocks from the Silurian upwards is represented, although the complete sequence recognized has not been found in any one boring. A very clear diagrammatic section is given showing the active collieries and working seams of the Kent Coalfield. Water, however, is fundamentally the most important of the economic resources of the Wealden District, since practically all that is used is derived from underground sources.

"Bristol and Gloucester District"[3] extends from the Forest of Dean across the Severn to the Cotteswold and Mendip Hills. Geologically speaking, it is one of the most varied districts of Britain, for, with the exception of the Ordovician

and possibly the Permian, there is exposed at the surface every geological formation from the Cambrian to the Cretaceous. Scenically, some of the most striking features, including caverns, gorges and bare rocky crags and uplands, are developed from the Carboniferous Limestone. On the west, limestones again dominate the scenery, the Inferior and Great Oolites forming the mural scarp of the Cotteswolds. These great limestone formations have attracted many famous geologists, the names of Arthur Vaughan and S. S. Buckman being pre-eminent as a result of their classic work on zoning. Tectonically, the synclinal areas of the Bristol, Somerset and Forest of Dean Coalfields and the echeloned periclines of the Mendips are of special interest.

"South-West England"[4] is a region of high moorlands, including the Devonian rocks of Exmoor and the Quantocks, and the granite masses from Dartmoor to Land's End and the Scilly Isles. At the base of the geological sequence lie the Pre-Cambrian rocks of the Lizard and Start Point. In 1834, De la Beche had already produced a geological map of Devon which led to his appointment as the first Director of the newly established Survey. Since then the region has been famous not only for the pioneer investigations of its mineral wealth, but also for the many contributions it has stimulated to our knowledge of petrology generally, culminating in the work of Teall, Flett, Dewey, and, still more recently, of Brammall and his school of co-workers. This handbook is itself a most valuable introduction to a great variety of petrological problems and there is, moreover, a most interesting section on mines and mining.

The handbook entitled "The Welsh Borderland"[5] covers a region from Shrewsbury to south of Monmouth. It includes such geologically classic areas as the Wrekin, the Longmynd and the Malverns, where some of the most ancient rocks of England and Wales appear boldly at the surface; the Stiperstones and Shelve country and the Breidden Hills, where Ordovician rocks are magnificently displayed; and Wenlock Edge, famous in the sequence of the Silurian System which was first established by Murchison in 1835 as a result of his work in the Welsh Borderland. Much of the modern research in the region was initiated by Lapworth and Watts, whose stimulating example has been vigorously followed by a host of colleagues and former students. Indeed, many geologists have received their field-training in this area, which is unrivalled for the great variety and interest of its formations, many of which, moreover, are highly fossiliferous. The present handbook provides an invaluable guide to the classes who annually visit Shropshire and the country about the Malverns for instruction in field-geology.

Another classical region in the history of geology is dealt with in "North Wales"[6]. Here Sedgwick set himself the task of disentangling the structure of the rugged mountain district of Snowdonia and Lleyn, and here he founded the Cambrian System. Since then North Wales has attracted to its study an ever-growing band of stratigraphers, palæontologists and petrologists. The region is essentially characterized by Lower Palæozoic rocks, displaying one of the finest sequences of Cambrian, Ordovician and Silurian strata to be found in Europe; showing by deep-seated erosion the cores of ancient volcanoes; and revealing in its crumpled, folded, cleaved and fractured sediments the record of several periods of major earth-movements. Of the remaining systems, the underlying Pre-Cambrian is well represented in Anglesey, while the Carboniferous and New Red Sandstone cover fairly extensive tracts on the borders. Like the foregoing, this handbook will be in great demand by students attending geological field-courses.

"The Pennines and Adjacent Areas"[7] include the Fell country from Stainmore Pass to the Craven district, consisting mainly of Carboniferous Limestone; the Central Pennines between Skipton and the Peak, largely formed of the Millstone Grits (and shales); the Derbyshire Hills of Carboniferous Limestone; the Lancashire and North Staffordshire Coalfield on the west; and, on the east, the coalfield of York, Derby and Nottingham which, in potential resources, is the most important in Britain. The great diversity of geological and physical features is accompanied by an even greater variety of economic interest and by a corresponding inequality in the distribution of population. The oldest rocks in the region—apart from the supposed Pre-Cambrian of Ingleton—are the Lower Palæozoic formations exposed in the valleys below Ingleborough and in the Howgill Fells. The interest of the coalfields needs no stressing, but geologists will particularly appreciate the useful summary of the structure of the region and the excellent account of the Pleistocene glaciation.

Northumberland, Durham, the Lake District and the Isle of Man are dealt with in "Northern England"[8]. The Northern Pennines continue to the Border and separate a great coalfield on the east from the most attractive scenic area of England, an area which is itself fringed with coal and iron fields. The formations range from the Ordovician to the Jurassic and include a long history of igneous activity, the products of which are responsible for the rugged hills of Borrowdale; the worn-down volcano of the Cheviots; the

well-known granites and Carrock Fell complex of the Lake District; the Great Whin Sill, surmounted for a considerable length of its outcrop by the Roman Wall; and a swarm of dykes which has been traced across Scotland to the Tertiary volcano of Mull. Along the Durham coast, the Magnesian Limestone of the Permian System constitutes one of the most puzzling formations—lithologically and structurally—to be found anywhere in the world. The results of much recent work in the Lake District have been incorporated in the handbook, but in a future revision more attention might be given to the North Pennine ore-deposits and to the Tertiary dykes, or at least to the desirability of including bibliographical references to these subjects of recent research.

"The South of Scotland"[9] is devoted to the region between the Cheviots and Solway Firth on one hand, and the faulted southern margin of the Midland Valley on the other. Here some of the fundamental principles of geology were established by Hutton and recorded in his "Theory of the Earth" (1795). It was in the Southern Uplands, too, that Lapworth began the far-reaching studies in which he demonstrated the value of graptolites as aids in working out the complicated succession and structure of a highly folded region. The area is mainly occupied by Ordovician and Silurian strata folded in part after the Arenig and, as a whole, at the close of the Silurian. The intrusions of serpentine and other plutonic rocks which have usually been regarded as pre-Glenkiln are considered by Dr. Pringle to be part of the Pre-Cambrian floor on which the Arenig strata were deposited. Small areas of Old Red Sandstone, Carboniferous and New Red Sandstone occur, with abundant illustrations of igneous activity in the great granite complexes of Galloway and the volcanic rocks and necks of Lower Carboniferous age. This handbook, like the one that follows, has a selected bibliography after each section, in some respects a preferable arrangement to placing the whole at the end. The map of the region, showing many localities of geological interest not easily found on detailed maps, is particularly clear.

"The Grampian Highlands"[10] embraces the region between the Highland Boundary Fault and the Great Glen Fault. It excludes Arran, but is extended to take in Colonsay. The two fault lines represent great dislocations along which movements are still taking place, as witnessed by the earthquakes which occur about Inverness and Comrie. The district includes the highest ground in Britain and is geologically by far the most difficult on account of the inexplicable complexity of its structure. The most important formations are those of the Moine and Dalradian divisions of the Highland Schists. A particularly valuable feature of the handbook is the clear summary which it contains of the different interpretations of succession and structure which have been proposed; this is the more useful because, as the author says, "it will doubtless appear to the reader that there are as many opinions as observers". The treatment of the igneous rocks earlier than, or associated with, the Dalradian metamorphism, and that of the Newer, or Caledonian, intrusions is also worthy of special praise. All students of tectonics and petrology will find this handbook a most helpful guide to a region of tantalizing perplexity.

Under the title "Scotland: The Tertiary Volcanic Districts"[11] the magnificent record now exposed in the west of Scotland, of the intense and prolonged igneous activity which broke out in Early Tertiary times, is discussed. The vast amount of denudation which has since taken place has revealed the extensive roots of mighty volcanoes and the deeper-seated plutonic rocks that crystallized beneath the covering of lavas. The complexity of the vents and intrusions and the orderliness of the ring-structures (ring-dykes and cone-sheets) are unsurpassed in any other part of the world. Only brief accounts of the pre-Mesozoic formations are given, the bulk of the handbook being devoted, as its title indicates, to (*a*) the plateau lavas; (*b*) the Central Intrusion complexes of Mull, Ardnamurchan, Skye, Rum, St. Kilda and Arran; and (*c*) the dyke-swarms. This justly famous petrographic province has stimulated world-wide discussion of problems of petrogenesis. In this connexion it may be pointed out that the official interpretation of the upward passage of gabbro into granophyne in the ring-dykes of Mull as the result of gravitational differentiation *in situ* has not remained unchallenged. The handbook is lavishly illustrated and, at least for petrologists, it may be hailed as the most attractive example of a series that is a worthy commemoration of a hundred years of geological research in Britain.

[1] "London and Thames Valley." By R. L. Sherlock. Pp. 70+5 plates.

[2] "The Wealden District." By F. H. Edmunds. Pp. 85+13 plates.

[3] "Bristol and Gloucester District." By F. B. A. Welch and R. Crookall. Pp. 86+12 plates.

[4] "South-West England". By H. Dewey. Pp. 75+12 plates.

[5] "The Welsh Borderland." By R. W. Pocock and T. H. Whitehead. Pp. 81+11 plates.

[6] "North Wales." By B. Smith and T. N. George. Pp. 92+12 plates.

[7] "The Pennines and Adjacent Areas." By D. A. Wray. Pp. 87+11 plates.

[8] "Northern England." By T. Eastwood. Pp. 76+8 plates.

[9] "The South of Scotland." By J. Pringle. Pp. 97+7 plates.

[10] "The Grampian Highlands." By H. H. Read. Pp. 81+10 plates.

[11] "Scotland: The Tertiary Volcanic Districts." By J. E. Richey. Pp. 115+9 plates.

London: H.M. Stationery Office. 1*s*. 6*d*. net each.

# Obituary

## Lieutenant-General Sir Alfred Keogh, G.C.V.O., G.C.B., C.H.

IT can scarcely be doubted that, by coming generations, the Great War will be held to mark an epoch in the history of medicine. Taking medicine in its widest sense, as a calling centred on the preservation of life and the mitigation of human suffering, its historian will have to go back to the day of Lister for anything comparable to the rapid and marvellous advance that was made during the War. The two cases are certainly widely different. Lister, like Pasteur, stands in solitary grandeur on the plains of peace, conferring after laborious days the splendid and enduring gift which his rare genius had put into his hands to bestow. In the case of the War, many great names are involved—it was team-work on a titanic scale. No one man among them stands as Lister stood among his fellow labourers. But moving about among the soldier and civilian members of the medical profession who are most competent to judge, the impression is left that if a name were to be chosen for the seat of honour, none could come before that of Sir Alfred Keogh, whose death at the age of seventy-nine years occurred on July 30.

Of talent of almost every kind, the Briton, like the men of other nations, is apt to say we have no lack; but in the art of fostering talent, of affording it the best field for action, of bringing it into focus on the things that are of most vital concern to the nation, the Briton is much less inclined to boast. Of the master art of the harmonious control of gifted men, it is still less the case. Here indeed lies the loudest complaint to-day about the expiring generation, and here also arises the haste to organize, systematize, rationalize, and almost, if one may be permitted to say, to 'Germanize' our ways. According to the adage, "It is lawful to learn from the enemy; it is both wise and lawful to learn from a friend who may also be a potential enemy". This in the Great War meant that Lord Haldane, when Minister of War, had embodied in the administration of the army sufficient of the ways of the German General Staff to help him in securing that six divisions were ready for instant embarkation to the field of war in August 1914, going at once into action. This, according to Earl Haig, was the foundation of victory.

Sir Alfred Keogh's appointment as Director-General of the Army Medical Services was almost simultaneous with that of Lord Haldane as Minister of War. It would, perhaps, be adding too much in praise of Lord Haldane to say that he had at once taken the full measure of the man whose appointment was to mean so much. Suffice it to say, that in Sir Alfred Keogh there was embodied all that was best in the ways of the German General Staff and all that was best in the military traditions of our own country. He was, however, not an imitator, but a man in whom great powers of initiation were inborn.

It would be out of place here, and beyond the writer's power, to give in any detail the record of Sir Alfred Keogh's work in the army. Its essential character can only be briefly indicated. In the first place, the imagination of Keogh, like that of his illustrious fellow countryman Earl Roberts, had enabled him to foresee in wonderful degree the conditions which would obtain in Great Britain in the event of foreign war. He foresaw its magnitude, and the scale of preparation that was required. On the formation of the Territorial Army, under Haldane's regime, Keogh laid, along with it, the foundation of a vast voluntary civilian medical service, which at the outbreak of war sprang into action, appearing with its great military hospitals, staffed with men of the highest medical skill, and the countless number of voluntary aid detachments, with their minor hospitals and training centres. He blended the civilian medical profession and the Army medical service and effected a perfect liaison between the organizations in the field and the organizations at home. It is confidently stated that no other army had its like in the efficiency of its medical service. How many thousands are there to-day, alive; how many thousands are there repaired, who in the conditions of any preceding war would have perished, or been left with grave injuries of kinds which grew to be remediable during the Great War?

The Army Medical Services were not prepared for everything. Among the unforeseen conditions of war in the field, no more conspicuous case could be cited than that of the outbreak of gas warfare. If foreseen as a possibility by Keogh, he, like other soldiers, regarded its incidence as so unlikely that he had no measures of defensive protection designed or in readiness. The results of this, if ever revealed in detail, would serve like the exception that proves the rule to show how much danger must have been entailed by any gap in Keogh's prevision and provision. He did all he could on the spur of the moment amid the toils of hard labour, to meet the new peril, and happily the co-operation of another born leader of men, Sir Henry Thuillier, brought the protection of troops against gas in advance of the attack, and kept it so up to the end of the War.

Keogh was ever ready to listen to proposals that came from people whom he could trust. He assumed no pontifical air; he was rather the supreme and vigilant officer, under whose direction the collected legions of the profession, and the collected outcome of medical investigation at home, passed without delay to wherever lay the appointed place in the field of war.

Turning now to the other field in which Keogh worked, we might stop to say much on the position of medicine in relation to experimental science. It might well be contended that Keogh in his Great War work exhibited the scientific method. He certainly

had imagination, a real love of science, and far more of real science in him than most medical men. If he is not strictly to be regarded a man of science, at least he believed in science wholeheartedly, and knew its ways. This gave him one great qualification for an administrative scientific post, and when we add to this his administrative achievements, as D.G.A.M.S. before the War, we cannot wonder that Lord Haldane, best aware of them, urged in 1910 the appointment of Keogh to the rectorship of the Imperial College of Science, which at that time, above all things, needed a talented administrator at its head. This post Keogh held actively from 1910 until 1914, when he was recalled to his old position at the War Office.

After the War, Keogh returned to it eagerly, and retired reluctantly from it only when he reached the age of sixty-five years in 1922. How much he loved the work can be gauged from the fact that at the most critical period of the War he said, with a rueful smile to the writer, that he was longing "to get back to South Kensington". Many readers of NATURE will have personal recollections of Keogh at the Imperial College. They may, perhaps, be puzzled to pick out any conspicuous act of reorganization likely, outside the College, to be associated with his name. If those who had the happiness of holding teaching or other office at the College during his rectorship are asked what he did, they too cannot, or will scarcely stop to tell you. For all thoughts of what he did are overwhelmed by the thought of what he *was*.

Keogh was above all else a veritable knight, a Christian Irish Catholic gentleman, endowed with all the graces that these words imply, not forgetting the savouring salt of humour. No wonder he was so much beloved by those who were nearest to him, and honoured and respected by those further removed who came into contact with him. By his War work he earned his place among the greatest who have served mankind, and incidentally to the work, he stood a noble figure bent on the advancement and right use of natural science. A. S.

## Mr. R. R. Webb

ROBERT RUMSEY WEBB, the last of the famous coaches for the old Mathematical Tripos, died in Cambridge on July 29, at the age of eighty-six years. He was born at Monmouth on July 9, 1850 and went up to St. John's College, Cambridge, in 1868 as a sizar. In 1870 he was admitted a scholar of the College; in 1872 he was Senior Wrangler and first Smith's Prizeman. His election to a fellowship followed immediately; in 1878 he was appointed College lecturer in mathematics, holding this post until 1911; from 1878 until 1893 he was also lecturer at Emmanuel College. He retained his fellowship until his death, and he lived in rooms in College until a few years ago, when he moved to the house of his former 'gyp'.

From the date of his degree, Webb devoted his energies to training pupils for the competitive struggle of the Tripos. He was one of the famous line of coaches which included Hopkins, Routh and Besant; he worked his men hard, but, as the letters which appeared in *The Times* after his death testify, he inspired and retained their affection, as well as their admiration for the masterly way in which he could manipulate such things as 'moving axes' in rigid dynamics and differential geometry. Naturally, in later days, after he had given up dining in Hall, for reasons variously reported, he became somewhat of a legendary figure. For example, the story was told that, in term time, after a strenuous morning's teaching, it was his invariable practice to go by train to Royston and walk the thirteen miles back to Cambridge, arriving so precisely at the same time each day that the College porters set their clock by him.

Webb did not take a great share in University business, though to the end of his life he was keenly interested in what was going on and, even in his seclusion, he always seemed to know the latest gossip. He examined four times for the Mathematical Tripos; the present Vice-Chancellor of the University recalls how hard he was made to work solving Webb's problems, and how much mathematics he learnt, when he was a co-examiner in 1905 and 1906.

Webb's published work is small in volume, but he was always interested in the progress of mathematics, and kept in touch with many of its developments, even after his retirement; his rooms were crowded with mathematical periodicals and treatises, as well as with paper-backed novels, in French and other languages. He had been a member of the London Mathematical Society since 1873 and he certainly attended one meeting, in January 1878, when the minutes record that "Prof. Cayley gave an expression for the surface of an ellipsoid which had been communicated to him by Prof. Tait", and "Mr. Webb made a few remarks upon the subject". On this occasion, Webb was persuaded to print his own version, and the result is "Some Applications of a Theorem in Solid Geometry" (*Messenger of Math.*, **9**, 170; 1880), one of eight papers appearing under his name in the *Messenger*, vols. 9–11, the most considerable of which deal with dynamics and elasticity. He also published a paper on attractions in the *Quarterly Journal* (**14**, 98; 1877), and communicated in 1886 a short note "On the Problem of Three Moments" to the Cambridge Philosophical Society (*Proc.*, **6**, 42; 1889). But he never could be persuaded to work up into a book any of his numerous manuscripts, which he was so generous in lending.

WE regret to announce the following deaths:

Prof. Henry Sewall, emeritus professor of medicine in the University of Colorado, an authority on human physiology and tuberculosis, on July 8, aged eighty-one years.

Mr. C. F. Talman, meteorologist in the U.S. Weather Bureau since 1922, on July 24, aged sixty-one years.

Prof. Frédéric Wallerant, formerly professor of mineralogy in the University of Paris, aged seventy-eight years.

# News and Views

## Television in the Home

ON the occasion of the opening of the Radio Exhibition, referred to on p. 410 of this issue, on August 26, an opportunity was provided by Messrs. Baird Television, Ltd., of witnessing the reception of the television programme broadcast from the B.B.C. station at Alexandra Palace. The demonstration was given on a standard Baird Televisor receiving set installed in the company's offices in Haymarket, under conditions which approximated to reception in the home. The receiving set was contained in a cabinet similar to the ordinary radio-gramophone, the picture on the screen of the cathode ray tube being viewed in a mirror in the raised lid of the cabinet. This picture was of such dimensions and height that it was comfortably visible by the viewer seated on a settee at a distance of about ten feet. The transmissions from the Alexandra Palace are, of course, only experimental; but the direct-vision pictures provided, including half or three-quarter length views of single persons, such as the announcer and a singer, were very satisfactory. The bulk of the programme, however, comprised the transmission of sound films, and while these were good on the whole, they emphasized the somewhat limited field of the vision picture by a loss of detail when this picture covered a large area or a crowd of persons. As an indication of the present-day possibilities of practical radio-television, however, this demonstration was most successful.

## Dr. J. H. Hutton

IT is announced that Dr. John Henry Hutton has been appointed a lecturer in the Faculty of Archæology and Anthropology in the University of Cambridge, for a period of three years as from October 1. When the intention to appoint a lecturer in this Faculty was notified in the course of last term, it was intimated that a special knowledge of the peoples of India would be a requirement. In this respect, Dr. Hutton's qualifications are beyond question. As a member of the Indian Civil Service, which he entered in 1909 after taking his degree at Worcester College, Oxford, Dr. Hutton has made a special study of the ethnography of the Nagas of Assam. Not only is he himself the author of two of the volumes in the series of monographs published under the auspices of the Government of Assam, one dealing with the Angami Nagas (1921) and the other with the Sema Nagas (1922), as well as a contributor of numerous papers on Naga culture to scientific periodicals, but he has also so stimulated and organized the researches of his colleagues that the hill tribes of Assam are now as well, or even better known to anthropological science than any other comparable population of India. When Dr. Hutton was seconded under the Government of India to take charge of the Census of India, 1931, it was generally felt that no more suitable selection could have been made. His introduction to the Report marked him as no unworthy successor to the late Sir Herbert Risley. However much opinions may differ as to the validity of the conclusions on the racial history of India at which Dr. Hutton arrived in that remarkable document, it cannot be denied that he has shown a notable breadth of outlook in grasping the essentials of his problem in their archæological and historical perspective, combined with a detailed knowledge of the multifarious facts, which is without rival in the Indian field.

## Economic and Military Armaments

IN the eighth Richard Cobden Lecture entitled "The Common Menace of Economic and Military Armaments" delivered on May 25 and now published (Cobden-Sanderson, Ltd., 1s. net), Prof. W. E. Rappard, discussing the relations between economic and military armaments, points out that as military armaments have contributed to the development of economic armaments, so the latter in turn have promoted the extension of military armaments by emphasizing the claims of the national State as against the rights of the individual and of mankind, and thereby increasing the tension in international relations. Both economic and military armaments are largely the legacy of past wars or the fruit of anticipation of future wars. Their primary source, however, is the doctrine of political nationalism which leads nations to look upon their own State as a universe in itself and therefore to disregard the rights of all others. A further source is in the present depression and in the efforts to overcome it by thorough-going State intervention.

BOTH economic and military armaments are weapons forged to enhance the independence, security and power of the national State. While a burden to the individual and a menace to the international community, they are incapable even at this price of truly fulfilling their professed purposes, and the present international situation must inevitably be aggravated by a persistent adhesion to these methods. Discussing the difficulties due to the existence to-day of at least three Great Powers of professedly and defiantly nationalistic Governments, Prof. Rappard suggests that the problem of international peace resolves itself into one of national ideals and conversions. Unless these nations can be led to adopt a more humane and less exclusive creed, peace can only be maintained by the closest co-operation between all those States, which, while respecting their own as well as their neighbours' statehood, still believe in the legitimate rights of the individual and in the supreme rights of mankind. Without a federal organization of the international community, there can be no real liberty, no lasting peace and no true relief from economic and military armaments.

### Maiden Castle, Dorchester

THE most striking point to emerge from this season's excavations at Maiden Castle, so far as they have gone, is the conclusive evidence confirming Dr. Mortimer Wheeler's inferences as to the importance of the pre-Roman fortress-settlement in Britain. Should further investigation confirm his views as to its prevalence as an organized system, this should have a profound effect on theory as to the origins and form of town life in early and medieval England. The importance of Maiden Castle itself may be gauged from the evidence now being found of the deliberate destruction of the walled system of defences when the inhabitants were removed in Roman times to the newly founded neighbouring city of Dorchester. As investigation proceeds, the character of the prehistoric stone walling, which has now been found incorporated in the ramparts, and of which the existence was previously unsuspected, becomes more and more impressive. These walls were built of limestone from Upwey, some of the blocks weighing as much as five hundredweight. At the eastern entrance a later wall of fine masonry now being uncovered still stands to a height of six courses. Not only is it evident that it overlies earlier prehistoric levels of occupation, but it is also clear that it was designed to form a blocking wall across the prehistoric gateway when the hill-top temple was being built in the century preceding the coming of the Romans. Within the fortress itself, the remains of a substantial structure of wood, standing at the highest point of the camp, is being excavated. This was evidently of considerable size, and was in part constructed of tree-trunks a foot in diameter. Nearby a skeleton was found buried at some depth, an unusual feature in a fortress. The excavations will be continued until the end of the present month, when the three years' investigation which was undertaken by the Society of Antiquaries of London with the co-operation of the Dorset Natural History and Archæological Society will have been completed.

### Meare Lake Village

EXCAVATIONS at Meare Lake Village have been resumed by the Somerset Archæological Society under the direction of Dr. Arthur Bulleid, and will continue until at least the middle of September. According to a preliminary report in *The Times* of August 29, the stone walling overlying the timber structure, apparently the foundations of a crannog, found last year in the central part of the eastern half of the village, is being examined further. The eastern margin and the south-eastern and north-eastern portions are now in course of investigation. Work has also been begun on the southern border of the village outside a definite dwelling. Timber and oak piles are being revealed, and in a layer of black earth a number of small finds have been made, which include a La Tène III brooch, a few objects of bronze, an antler weaving comb, a 'pygmy' pottery vessel, and a small Romano-British pot of the type known as 'Cossington' ware.

### im Thurn Memorial Lecture, 1936

IN the recent lecture for 1936 on the foundation in memory of the late Sir Everard im Thurn, delivered at Edinburgh, Prof. J. L. Myres directed attention to the effect of changing outlook and development in method of research on the broader philosophic principles, which underlay the work of im Thurn. To the study of primitive peoples he conjoined the application of its results to the practical problem of the approach to the primitive mind in administrative and other affairs. He realized that this problem was but the counterpart of any native's difficulty in understanding European ways. im Thurn, Prof. Myres pointed out, insisted on the significance of 'character' which, whatever the superficial changes in culture, continues to influence native reactions to 'civilization'. This 'civilization' was defined as that in which "the prime motive of human action was the good of others or of one's whole race". As regards 'character' and 'culture' and their interaction, all grades between the individual completely disciplined by 'culture' and the man of genius can be discerned.

SINCE im Thurn's day, advance in scientific method has shown that culture and character alike appear as a composite system, or complex of elements, combined in different peoples in infinitely varying degrees of intensity. In a society in which transitions from one phase of life and society are effected mainly by individuals in isolation, character and initiative stand high, and in that society institutions are relatively unstable. Where, however, the rites of transition are matters of public concern and are performed by whole groups of initiates, behaviour and social structure are stabilized, character is stereotyped, originality suppressed and stagnation ensues. Our knowledge of 'primitive' cultures is mainly derived from such societies. Out of such closed cultures what way of escape is there, Prof. Myres asked. How does what im Thurn defined as civilization emerge as an altruistic prime motive of human action? Prof. Myres illustrated from the history of ancient Egypt, early Greece and elsewhere how in fact such transformations do take place, though they do not preclude the apparition of a dominant individual character as first cause, and they presume elementary freedom to choose the well-being of others, once presented as the prime motive of human action.

### Bibliography of Natural History

THE first general meeting of the Society for the Bibliography of Natural History was held in the rooms of the Royal Entomological Society on August 26. The provisional committee set up to establish the Society made a report and submitted draft by-laws which were accepted as the by-laws of the Society. The following officers were elected: President: Dr. C. Davies Sherborn; Treasurer: Mr. Francis Hemming; Secretary: Mr. Francis J. Griffin; and a committee of management set up consisting of Prof. F. Balfour-Browne, Mr. J. R. Norman, Mr. J. Ramsbottom, Dr. T. A. Sprague and Mr. A. Cockburn Townsend. It was announced that

the first part of the Society's *Journal* would appear in September, and that it would contain a catalogue of all known papers giving information relating to the dates of publication of books on natural history. No such catalogue at present exists, and the publication should be of value to all systematists. An item on the programme of the Society which it is hoped will be of great value to all naturalists is the publication of facsimiles of rare works of importance to natural history. The decision of the Society to maintain an information bureau for the use of its members is an indication of the present trend of societies to make available to the individual member the collective experience and knowledge of all. The annual general meeting of the Society will be held on the first Saturday in February.

### International Botanical Congresses

A FEATURE of the sixth International Botanical Congress held at Amsterdam last September was the re-organization of the Botanical Section of the International Union of Biological Sciences and its recognition by the Congress as a liaison between successive International Congresses. Hitherto, each quinquennial congress has been independent of preceding congresses, and has been organized entirely by an *ad hoc* committee of the nation which was acting as host. Participation by other nationals in its various activities was by invitation. A drawback of this arrangement has been the absence of any body to ensure that resolutions passed by one congress were carried out and that committees appointed for definite objects were set to work. A circular has now been issued by the honorary secretary of the Botanical Section of the Union describing the aims of international collaboration in science in general, and in particular defining the work of the Botanical Section in relation to successive congresses. The circular emphasizes the independence of the quinquennial congresses, the organization of which remains entirely in the hands of a national committee; but the various commissions and committees appointed by successive congresses will be adopted by the Botanical Section of the Union and thus "be united into a permanent, active and well-subsidized organization". This should ensure that work initiated at any one congress will be effectively carried out. For the present a definite liaison is suggested between the two organizations as the president of the Botanical Section of the Union, Prof. N. E. Svedelius, is vice-president of the next International Congress to be held in Stockholm in 1940. The president of the Congress is Prof. R. E. Fries.

### Forestry Research in Canada

As a result of recommendations made at a Conference on Forestry Research held in Ottawa in November 1935, the National Research Council of Canada has appointed a committee to study the requirements in respect to research in all branches of forestry, including measures for the better utilization of forest products. This committee is to function as an associate committee of the National Research Council, and includes in its membership representatives of the Dominion Departments of the Interior and Agriculture, in addition to the National Research Council; the forestry departments of each province; members of the forestry faculties of universities in which there are departments of forestry; the lumber, pulp and paper and allied industries throughout the Dominion; the forest engineering societies; the forest protective associations and the Canadian Forestry Association. It is understood that the committee will base its preliminary programme on the findings of the Conference on Forestry Research held in November 1935 already alluded to. The importance of forestry and her forests to Canada needs no emphasizing. Much valuable work is being done already in the direction of research by federal and provincial agencies, individual companies and other organizations. The new committee will bring together data on the work at present in progress, correlate the information thus obtained, investigate the need for further research, and so forth. It is evidence of broad and statesman-like views among those responsible for the formation of the committee that representatives of all sides of forestry interests are included. In Great Britain, the position is far otherwise—research work is too often relegated to water-tight compartments, energies being thus dissipated; forestry committees are not fully representative of all sides of forestry; whilst representatives of the individual forestry staffs of the universities as a whole do not automatically find places on forestry research committees.

### Control of Rabbit Infestation by the Use of a Virus

OF all the pests from which the pastoral industry in Australia has suffered, rabbit infestation is probably the most serious economically, and little permanent success seems to follow the methods of control in use at present, such as trapping and poisoning. One hope would appear to lie in the discovery of some infectious disease, deadly to the rabbit but innocuous to man and other animals, and easily communicable to, and spreading widely by natural means among, the rabbits. Sir Charles Martin, as a result of an experimental inquiry, suggests that a disease 'rabbit myxomatosis' may fulfil these requirements (Commonwealth of Australia. Council for Scientific and Industrial Research, *Bull.* No. 96. Melbourne, 1936). This is an infectious, highly fatal, febrile disease caused by an ultra-microscopic virus, causing mucinous discharges, swellings and tumours in affected animals, fatal within twelve days or so, transmitted sufficiently by contact, and with a fatality of almost a hundred per cent. It attacks animals of the genus *Oryctolagus*, to which wild rabbits in Europe and Australia, and domesticated rabbits in Europe and America, belong; but it does not affect the indigenous rabbits of America, or man and other animals and birds. Experiments were conducted by Sir Charles Martin in a pen measuring 50 yards × 10 yards, with both tame and wild rabbits. A colony having been established for three weeks or thereabouts, one or two rabbits inoculated

with the disease were introduced. With colonies of 27 and 30 tame, and 55 and 44 wild, rabbits, the fatality was 99·6 per cent among the tame, and 100 per cent among the wild. The disease originally came from epizootics among tame rabbits in South America.

### Research at Millport

THE Annual Report of the Executive to the Council of the Scottish Marine Biological Association for 1934–35 includes the director's report on research. Drs. Orr, Marshall and Nicholls are concentrating on the development and food of the herring from hatching onward. In this connexion, it is found that copepods are by far the most important food organisms, the larval and post-larval herring eating chiefly the small species. In view of this fact, it was decided to investigate seasonal distribution and breeding periods of these small copepods, in the same way as has already been done for *Calanus finmarchicus*. Results so far show that in the early months *Microcalanus pusillus* and *Oithona helgolandica* were the most abundant species, with *Pseudocalanus elongatus*, *Centropages hamatus*, *Temora longicornis* and *Acartia clausi* occurring in smaller numbers. Most of the important planktonic organisms have been weighed, and in some cases the chemical composition determined. During the winter, when zooplanktonic organisms are scarce, a beginning was made on the analysis of non-planktonic animals important as fish food. Investigations on shore ecology, especially in Kames Bay, by Dr. A. C. Stephen and Mr. Elmhirst, have been continued. The work already done has shown a very rich fauna important for fish food. Various fishes from the seine net have been examined and shown to feed on the dominant invertebrates. A very interesting feature in these investigations is the work by Dr. Nicholls on sand-dwelling copepods, especially minute species living in the interstices between the sand grains on the beach. Several new species of these and three new genera have been found. Other researches include algal ecology and preserving colour in green seaweeds, experiments on timber preservation in the sea and the growth of the dog-fish *Acanthias*.

### Seismology in New Zealand

THE report of Dr. C. E. Adams, Dominion Astronomer and Seismologist, for the year 1934 (*Dept. Sci. Indus. Res. Bull.*, No. 105) shows that the seismic activity of New Zealand was much greater during that year than in 1933, the number of earthquakes felt being 230, instead of 108. Of these, 158 were felt in the North Island only, 60 in the South Island only, and 12 in both islands. The most important shock was that of March 5 at 11.16 p.m. N.Z. time (11.46 a.m., G.M.T.). Its intensity in several parts of northern Wairarapa reached the degree 9 of the Rossi-Forel scale and chimneys fell over a wide area in the southern part of the North Island. The map that accompanies the paper shows that most of the epicentres lay in the extreme north of South Island and the southern half of North Island. Owing to the increased activity off the east coast of the latter island and to other changes that have been reported along the coast, it is strongly recommended that a detailed marine survey should be carried out of the whole east coast, including soundings in the seas to the east of New Zealand.

### Solar Activity and Terrestrial Phenomena

IN 1924 the International Research Council (now transformed into the International Council of Scientific Unions) formed a Commission for the Study of Solar and Terrestrial Relationships, a field of science which extends over the domains of at least three of the International Scientific Unions. This Commission, among other activities, has published triennial reports, reviewing the state and progress of knowledge on solar and terrestrial relationships, and, where necessary, making recommendations regarding action that may conduce to further progress. These reports are distributed to certain libraries and to institutions and individuals occupied in work relating to the subject. The fourth report has recently been issued (Conseil International des Unions Scientifiques : Quatrième Rapport de la Commission pour l'Etude des Relations entre les Phénomènes Solaires et Terrestres ; pp. 159. Firenze, 1936) under the editorship of the president of the Commission, Prof. G. Abetti, Astrophysical Observatory, Arcetri, Italy. It differs from its predecessors in being better and more attractively produced, and in having a valuable 28-page introduction by the editor, giving a general survey of the subject for the past three years. The remainder of the volume consists of twenty-one brief articles on different aspects of the subject, by various authors.

### Electric Supply in the Irish Free State

THE annual report of the Electricity Supply Board of the Irish Free State for the year ending March 31, 1936 shows that a further increase in the sale of electricity has been effected, and results in a surplus of income over expenditure of about £310,000. The total capital expenditure is now about 10¼ million pounds, of which 5 per cent is paid to the State. The total sale of electric units during the year amounted to 187 millions, and the average receipts per unit dropped from 1·92*d*. to 1·84*d*. The figures show a very satisfactory acceleration in the development of the consumption of electricity for domestic purposes. In the environs of Dublin the consumption increased by 63 per cent. The total units generated during the year were 243 millions, of which 211 millions were supplied by the hydro-electric power station on the Shannon. Details are given of the extension of plant, and the building of new works on the Shannon and at the Pigeon House in Dublin. Two Swiss experts have reported on the development of the River Liffey for hydro-electric purposes. As it is the intention of the Corporation of the City of Dublin to use the water-storage reservoir on the Liffey to augment the ordinary water supply to the city, it was found inadvisable to take full advantage of the Liffey water-power project for six or seven years. As soon as the necessary legislative provision has been obtained, the work on the reservoir will be

begun. The average yearly production of the Liffey hydro-electric development is computed to be 30 million units.

### Scientific and Technical Literature

SEVERAL suggestions for the improvement of scientific and technical literature are made by Commander T. W. Macalpine in the *Publishers' Circular and the Publisher and Bookseller* of July 18. Criticizing the present procedure followed by a specialist or a publishing company in regard to a projected scientific book, he suggests that the exposition of the subjects treated in scientific and technical works, etc., would be improved, their utility for easy and quick reference increased, the cost of production decreased, and their filing and storage on shelves, etc., facilitated, if there existed an independent body of recognized standing in the world of science which could furnish authors and publishers with general information and guidance. At present an author is rarely able to give much information of assistance to the publishers on such matters as form of treatment, size of volume, number of words, type or types, number and kind of illustrations, diagrams, paper, binding. Accordingly, the utility of a book is liable to be limited by the publisher's experience. An independent advisory body of recognized standing which could supply information on such matters, assist in the standardization of nomenclature and symbolism, as well as of formats and sizes of printed area on pages, and advice on subdivision, synopsis, contents list and index, etc., would make an important contribution to efficient publication.

### Composition of Cereal Straw

THE seemingly facetious title, "The Two Ends of Straw", appears over an article by Dr. H. Nicol in *Agricultural History* (**10**, No. 1, Jan. 1936), reviewing some early, but fundamental, research upon the composition of cereal straw. The work of Prof. J. F. W. Johnston in 1842, of J. P. Norton and P. F. H. Fromberg in 1845, and of J. I. Pierre in 1863 and 1866 is collected to show that straw has a great diversity of composition between the root end, and the parts towards the flower. The work of Pierre is particularly detailed, and supplies a great deal of material not widely known at the present day. Dr. Nicol discusses some of the results in relation to the recent hypothesis of 'negative migration' of plant constituents, where nitrogen and mineral elements are returned to the soil. Several additional papers upon the partitional analysis of straw have come to light since the publication of the article under review, but the most recent is dated 1879. There is considerable gratification, but also cause for humble reflection, that modern ideas are being confirmed by work which has remained in oblivion for nearly sixty years.

### Greenkeeping Research

THE spring number of the *Journal of the Board of Greenkeeping Research* (**4**, No. 14, from the Board's Research Station, St. Ives, Bingley, Yorks, 2*s.* 6*d.* net) contains the annual report of the organization, which shows, *inter alia*, a very gratifying volume of advisory work. Many suggestions for future work of a practical kind have been made by the Greenkeepers' Advisory Committee, and the report of last year's annual conference is embellished by the full text of Prof. N. M. Comber's address on "The Constitution of Soil". Mr. R. B. Dawson, director of the Research Station, contributes a short but highly informative article on camomile lawns, and the previous accounts of lawn grasses, of weeds, and of fertilizers, are continued. The difficulties of accurate botanical description are being met by the publication of a glossary of botanical terms. Mr. R. B. Ferro discusses some of the difficulties of field experimentation on the golf course. Two short articles on water installations, a description of the management of a golf course on heavy clay soil, and a plea for special investigation of bowling green problems, are included in the issue.

### A Journal of Marriage Hygiene and Birth Control

WITH the May issue (2, No. 4), *Marriage Hygiene* completes its second year. The objects of this quarterly journal are to secure for conjugal hygiene a proper place in preventive medicine, to publish scientific contributions treating marriage as a social and biological institution, and to promote and coordinate contraceptive clinics and marriage consultation centres in various parts of the globe. Each number contains notes and comments, original articles, reviews and abstracts of current literature. "The Positive Side of Birth Control" (E. B. Reuter), "Birth Prevention in France" (J. J. Spengler), and "Artificial Insemination" (H. Brewer) are some of the original articles in the present number. The yearly subscription for the volume of about five hundred pages is 18*s*. It is published from Kodak House, Bombay 1, India, the editor being A. P. Pillay. The London agents are Messrs. H. K. Lewis and Co., 136 Gower Street, W.C.1.

### Anti-Noise Regulations

THE City Council of Philadelphia has adopted a noise abatement ordinance prepared by a Special Committee of the Philadelphia County Medical Society. The ordinance prohibits sounding of motor-horns except when absolutely necessary for the prevention of accidents, building operations at night except by special permit, the use of sound devices by pedlars, unnecessary noise in handling rubbish cans, and the use of gongs, sirens or exhaust whistles on any vehicles except those of the police and fire bureaux, and hospitals. Loud playing of radios in homes or in front of stores is also among the specific noises forbidden in the ordinance.

### Costing Returns of Hospitals and Sanatoria

IN recent years, the value of costing methods in securing business efficiency has become increasingly recognised, not only in industry but also in local government. The Ministry of Health has issued Part 1

and Part 2 of the costing returns of hospitals for the year ending March 31, 1935 (H.M. Stationery Office, 1936. Price 1*s*. and 1*s*. 3*d*. net). Part 1 contains particulars of Poor Law hospitals, general hospitals administered by local authorities under the Public Health Acts or the Local Government Acts, sanatoria and other institutions for the residential treatment of tuberculosis, and maternity homes and hospitals. Part 2 contains the similar particulars for Poor Law institutions and separate casual wards.

### Research at the London Hospital

THE annual volume of "Researches Published from the Wards and Laboratories of the London Hospital during 1935" has recently been issued (London: H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. Price 7*s*. 6*d*. net). The matter has been selected and issued by the Publications Committee for Researches from the London Hospital, of which Prof. Bedson is honorary secretary. The volume includes twenty-seven papers, all published in various current journals, which cover a wide range of subjects included in the science and art of medicine.

### A Large Sunspot

THE rising solar activity continues to yield, amongst other phenomena, a fairly high frequency of sunspots —about six groups a day being visible. These groups are usually of moderate extent, but about a dozen seen since the beginning of 1936 may be discriminated as naked-eye spots. These spots or groups of spots have areas of not less than 500 millionths of the sun's hemisphere or about 585 million square miles. The latest of these large spots is now crossing the sun's disk, from August 25 until September 6, with central meridian passage on August 30·7 U.T. Its growth to a large spot with multiple umbræ was considerable between August 27, when its area measured 400 millionths, and August 29, when it had increased to 900 millionths. The spot was surrounded by extensive faculæ, as seen in integrated light, and by flocculi as seen in hydrogen light ($H\alpha$) or in that of ionized calcium (H and K). There was marked activity recorded with the spectrohelioscope at the Royal Observatory, Greenwich, on August 27 and 28—in particular a bright eruption, visible in $H\beta$ as well as in $H\alpha$, on August 28 between $10^h$ and $11\frac{1}{2}^h$.

### Announcements

FOLLOWING her record-breaking westbound passage across the Atlantic from Bishop Rock to the Ambrose Lightship, the *Queen Mary* has recently beaten the eastbound record. She passed Bishop Rock at 7.12 hr. G.M.T. on August 30, having taken 3 days 23 hr. 57 min. for the crossing. The average speed for the voyage of 2,939 miles was 30·63 knots, as compared with the average of 30·31 knots for the 3,015 miles which gave the *Normandie* the blue riband of the North Atlantic in June, 1935.

A WORLD Peace Conference is being held at Brussels on September 3–6. It has been organized by the International Peace Campaign; the Viscount Cecil and Pierre Cot are joint presidents; Miss Rose Manus, 48 Boulevard Botanique, Brussels, is the international secretary; Dame Adelaide Livingstone is vice-chairman of the British National Committee, which has its office at 27 Chester Terrace, Eaton Square, S.W.1. The Congress has special committees on medicine, science and education, and will raise general points, too, likely to be of interest to scientific workers.

DR. FRIEDRICH KÜSTNER, of Mehlem a. Rh., professor of astronomy and formerly director of the observatory of Bonn University, celebrated his eightieth birthday on August 28.

AN Institute for Industrial Medicine has recently been inaugurated in Milan.

THE twenty-fifth Congress of the German Society of Legal and Social Medicine will be held at Dresden on September 17–19. Further information can be obtained from Dr. Schrader, Lahnstrasse 9, Marburg a.d. Lahn.

THE Association for Photographic and Cinematographic Documentation in Science will hold a Congress in Paris on October 9–15. Further information can be obtained from Dr. Claoué, rue Scheffer 39, Paris, 16e.

ERRATUM.—In the letter entitled "Measurements of Cosmic Rays in a Deep Mine" by Drs. J. Barnóthy and M. Forró in NATURE of August 22, p. 325, lines 9 and 15, for "2,500 m." read "1,500 m."; line 15, for "0·09" read "0·18".

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in electrical engineering in the Borough Polytechnic, London, S.E.1—The Principal (September 9).

A lecturer in mechanical engineering in the Handsworth Technical College, Golds Hill Road, Handsworth, Birmingham—The Principal (September 12).

A junior bacteriologist in the University of Bristol —The Registrar (September 12).

A vice-principal (industrial and/or mining engineering) of the Wakefield Technical College—The Director of Education, Education Department, 27 King Street, Wakefield (September 14).

An assistant lecturer in mathematics in the University of Sheffield—The Registrar (September 15).

An investigator for research in problems of falls of ground and haulage in coal mines to the Safety in Mines Research Board—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, London, S.W.1 (September 19).

A demonstrator in mechanical engineering in the University of Leeds—The Registrar (September 21).

A regius professor of natural history in the University of Aberdeen—The Private Secretary, Scottish Office, Whitehall, London, S.W.1 (October 31).

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 407.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Radio-Helium

THE following experiment concerning the nature of the radioactive element produced in beryllium when bombarded by fast neutrons[1] was made on the suggestion of Dr. O. R. Frisch.

Beryllium was precipitated as a hydroxide in a very fine-grained form (this was kindly done for us by Prof. G. v. Hevesy), so that it might be able to give off any helium produced in the process. The $Be(OH)_2$ powder was bombarded by neutrons from a beryllium-radon source of about 200 mc. strength, and a stream of hydrogen was at the same time passed through the tube containing the $Be(OH)_2$ and then through a capillary tube to a thin-walled jacket around a thin-walled Geiger counter. The distance between the neutron source and the counter was 60 cm., and the latter was properly shielded by lead.

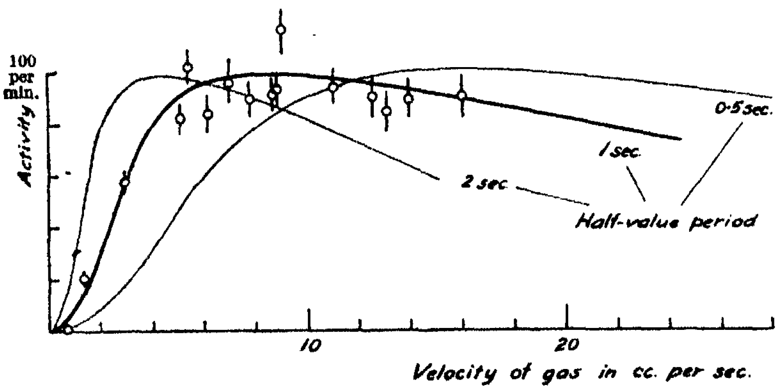



FIG. 1.

When the velocity of the gas was zero, the rate of counting was 20 per minute: when the velocity of the gas was increased, the counting rate increased as shown in Fig. 1, where the counting rate (less the γ-ray effect of 20 per min.) is plotted against the velocity of the hydrogen. This shows that a radioactive body in a gaseous state is produced in the $Be(OH)_2$. From the volumes of the $Be(OH)_2$ tube, the capillary and the jacket around the counter, one can calculate roughly the shape of the curve for the cases of the activity having a half-value period of 0·5 sec., 1 sec. or 2 sec. These curves are drawn in Fig. 1, and it is seen that the activity has a half-value period of about 1 sec., thus being identified as the one previously reported[1].

A radioactive gas produced by bombarding ${}^9_4Be$ by neutrons could scarcely be anything but ${}^6_2He$ or possibly ${}^8_2He$.

T. BJERGE.

Physical Laboratory,
Technical Highschool of Denmark,
Copenhagen.
July 29.

[1] T. Bjerge, NATURE, 137, 865 (1936).

## β-Ray Spectrum of Radio-Helium

IN order to investigate the energy distribution of the β-rays from radio-helium[1], we have employed an expansion chamber constructed by Dr. J. C. Jacobsen and kindly lent to us. In the middle of the top plate, a thin-walled brass cylinder (0·05 gm. per cm.$^2$, 1·5 cm. diameter) was inserted, into which an activated beryllium cylinder could be dipped. The latter was made of beryllium powder (0·12 gm. per cm.$^2$) stuck on to a brass tube (0·1 gm. per cm.$^2$) and could be moved automatically from a position around a neutron source (beryllium-radon) to the position in the Wilson chamber in 0·4 sec., this movement also starting the timing arrangement for expansion and light. A suitable lead shielding was arranged which cut down the electrons due to the γ-rays to a number small compared with the number of β-rays. The radioactivity induced in the brass tube carrying the beryllium is negligible as the latter is exposed to the neutrons only for a few seconds at most every minute.

The β-rays were bent by a magnetic field of 1,500 oersteds. The gas in the chamber was air at about half an atmosphere pressure, the condensing vapour a mixture of ether and alcohol.

Radio-helium emits negative electrons. 120 tracks have been measured and corrected for the stopping power of the brass cylinder and half of the beryllium layer. The uncertainty in the individual values of $H\rho$ is estimated to be about 10 per cent. The energy spectrum obtained is shown in Fig. 1. As usual, it is somewhat difficult to determine the

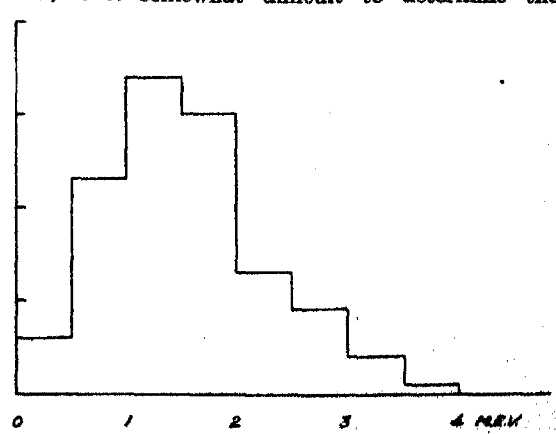



FIG. 1. Energy spectrum of β-rays from radio-helium.

upper limit: the scarcity of tracks in this region tends to give a value which is too low, whereas the

uncertainty of the individual tracks tends to give a value which is too high. We consider $3 \cdot 7 \pm 0 \cdot 5$ m.e.v. as the most probable value from our measurements.

The most reasonable assumption as to the formation and disintegration of radio-helium are the processes:

$$^{9}_{4}\mathrm{Be} + ^{1}_{0}n \rightarrow ^{6}_{2}\mathrm{He} + ^{4}_{2}\mathrm{He} \qquad (1)$$

$$\text{and } ^{6}_{2}\mathrm{He} \rightarrow ^{6}_{3}\mathrm{Li} + e^{-} \qquad (2)$$

If the energy release in (2) is $3 \cdot 7$ m.e.v., the mass of $^{6}_{2}$He would be $6 \cdot 0207$, using the masses given by Oliphant[2]. Recently Oliphant has reported[3] that (1) takes place even if the bombarding neutrons have only $1 \cdot 5$ m.e.v. kinetic energy. If these figures are applied in (1), it follows that the energy available for the breaking up of the intermediate $^{10}_{4}$Be nucleus into He and $^{6}_{2}$He is $0 \cdot 8$ m.e.v., which does not seem unreasonable.

We wish to thank Prof. N. Bohr for his interest in the work, and the Radium Institute of Copenhagen for the gift of the emanation.

T. BJERGE.
K. J. BROSTRÖM.
Institute for Theoretical Physics,
Copenhagen.
July 31.

[1] See preceding letter.
[2] M. L. Oliphant, NATURE, 137, 396 (1936).
[3] M. L. Oliphant, Copenhagen Conf. 1936 (unpublished).

## Passage of Fast Electrons through Matter

WHEN a fast electron passes through matter, it loses its energy mainly by emission of a few large quanta of radiation (*Bremsstrahlung*). The radiation quanta are absorbed again, the absorption being due mainly to the creation of pairs. Thus, in a *thick sheet of matter*, a fast primary electron produces quite a number of secondary positive and negative electrons, which appear as a *small shower* giving rise to triple coincidences, etc.

Using the cross-sections for the above processes as obtained from relativistic quantum mechanics[1], we have calculated the probability for the production of secondary electrons with an energy greater than $E$, say, when a primary electron of energy $E_0$ passes through a sheet of matter of thickness $L$. The result can be expressed in the same form for all materials if the thickness $L$ is expressed in certain units characteristic for the material. The unit thickness ($L = 1$) corresponds to:

0·40 cm. Pb; 7·4 cm. Al; 33 cm. $H_2O$; 280 m. air.

The average number of positive *or* negative electrons emerging from the sheet depends only on $L$ and the ratio $E_0/E$. It is given in the accompanying table (the total number of positive + negative electrons being twice the corresponding figure given in the table):

| $E_0/E$ | 20 | 100 | 400 | 1000 | 10,000 |
|---|---|---|---|---|---|
| $L = 2$ | 0·5 | 1·3 | 2 | 2·5 | 3·7 |
| 3 | 0·7 | 1·8 | 3·4 | 4·4 | 7 |
| 4 | 0·7 | 2 | 3·8 | 5·2 | 8·6 |
| 5 | 0·5 | 1·8 | 3·8 | 5·4 | 9·3 |
| 7 | 0·2 | 1·2 | 3 | 4·7 | 10·3 |
| 10 | 0 | 0·5 | 1·8 | 3 | 8·4 |

The results are only valid for $E \gg mc^2$.

The table shows that the maximum number of secondaries is produced at a thickness $L_m$ of about $3 \cdot 5 - 5$, increasing slowly with $E_0/E$. $L = 4$ corresponds to $1 \cdot 6$ cm. lead. For this thickness a primary electron of $2 \times 10^9$ e.v. produces, for example, on the average 2 positive and 2 negative electrons with energies greater than $20 \times 10^6$ e.v.

There can be no doubt that the process discussed above is responsible at least for a large part of the triple-coincidences obtained by Rossi and others. The thickness $L_m = 4$ ($1 \cdot 6$ cm. lead) at which the number of secondaries is a maximum agrees well with the maximum of Rossi's well-known curves[2].

Showers of this sort can also be produced by hard light quanta. After having travelled an average distance $L = 1 \cdot 7$, the light quantum creates a pair, each electron of which produces secondaries in the way described above.

A more detailed discussion of these processes and in particular of the higher stages (tertiary, quaternary . . . electrons) will be given elsewhere. The latter have to be taken into account for large values of $L$ and $E_0/E$.

H. J. BHABHA.
Cambridge.
W. HEITLER.
Bristol.
July 29.

[1] Bethe and Heitler, *Proc. Roy. Soc.*, A, 146, 83 (1934).
[2] Int. Conf. Nuclear Physics, London, 1934.

## Intrinsic Uncertainty of Reference Frames

PHYSICAL ideas which seem at first sight somewhat arbitrary become, as Eddington has stressed, almost inevitable when the relativity principle is taken to its proper conclusion. As examples may be quoted the law of gravitation, in which the radius of curvature anywhere *in the universe is proportional to the* corresponding amount of matter there, and the principle of unit weights (equal *a priori* probabilities) in statistical mechanics.

Eddington has pointed out further, following earlier ideas of Mach, that the *ad hoc* introduction in quantum theory of a term $m$ to represent mass is theoretically unsatisfactory, in view of the necessary dependence of such a term on the remaining unspecified matter. It seems logical to realize not only that relativity has denied the absolute independence of mass, space and time; but also that these concepts should rigorously be regarded merely as aspects of the configuration and changes of configuration of matter. On any kind of atomic theory it follows that these three associated concepts of mass, space and time are all statistical in character.

Any mechanical properties of a system will be implicitly affected by fluctuations in our frame of reference. If in particular we use the rest of the world as our reference frame, there will be an uncertainty of order $R/\sqrt{N}$, where $R$ is the radius of the universe, and $N$ the number of particles it contains. From this uncertainty, Eddington has considered what term should represent the 'reference mass' of the universe. If this statistical view of the origin of mass is accepted, it does not seem unreasonable that we should assume a corresponding uncertainty of the conjugate co-ordinate, proper time, of order $h/mc^2$ or $R/c\sqrt{N}$.

The above argument could thus be regarded as one approach to Flint's assumption that in addition to the usual limitations imposed by Heisenberg's uncertainty principle, there is a limit to the subdivision of proper time, from which postulate he

shows that a paradox of negative energy levels disappears[1]. It seems in any case significant that the order of these uncertainties is that at which it is known that wave mechanics begins to break down.

A further conceivable development of the argument is its connexion with changes associated with a direction of time. If recognizable changes of configuration could be imagined referred to an ideal time defined in terms of the number of interactions that take place, then as entropy increases, the approach of equilibrium will imply that more interactions will take place before a recognizable change occurs. If our observable time is regarded as dependent on recognizable change, then, being a statistical average, it will as a macroscopic phenomenon eventually disappear. Before this stage is reached, however, it will in terms of our ideal time go more and more slowly; and it could appear to follow, if we adopt conventionally a fixed relation between measurements in space and time (denoted by the constant $c$), that space will correspondingly expand. Equivalently, the velocity of light could be said to decrease, though it should be noted, *in* view of past suggestions (on rather insufficient evidence), that this velocity *is* apparently decreasing, that even the present observed expansion of space, whatever its cause, would, on the assumption of an absolute constant for the velocity, only give rise to an apparent decrease of about 16 cm./sec./year, which would be undetectable[2].

In spite of possible fallacies in the above arguments, they may serve to stress properties of an observable time that are now perhaps becoming appreciated. Thus it should be remembered that a clock is not merely an oscillating system that is observed at a particular instant—this would define in terms of space a periodic sort of time; if it has also to record its *number* of oscillations without disturbance, it begins to be a more complicated mechanism.

M. S. BARTLETT.
Jealott's Hill Research Station,
Bracknell, Berks.
August 6.

[1] NATURE, 137, 318 (1936).
[2] cf. Edmondson, NATURE, 133, 759 (1934).

## Genotypic Control of Chromosome Size

THE differences in size between the chromosomes of related species are usually differences that can be attributed to structural changes such as fusion, fragmentation, etc. In many groups, however, enormous differences of size are found, which may be of the order of 1 : 100 or even 1 : 1,000. Such differences, uniformly affecting as they often do the whole complement, must be due to a unitary genotypic control of chromosome size. In other words, the size of chromosomes, like other properties of the organism, must be subordinate to the action of the genes they carry[1].

Experimental examples of this principle are very rare, the only clear case being that of a bud sport in a triploid plant presumed to be a hybrid between diploid and tetraploid *Tradescantia* species with different chromosome sizes. The mutant had chromosomes 1/5 the size of the stock[2].

In experimental material of grasses[3], kindly supplied by Dr. T. J. Jenkin, of the Welsh Plant Breeding Station, Aberystwyth, I have been able to find evidence of the inheritance of this genotypic property governing chromosome size. A male sterile plant of *Lolium perenne* (Fig. 1, *A*), with chromosomes of about a quarter the size of the normal, was crossed with a normal plant and gave 8 male sterile seedlings, two of which were examined. One of them (Fig. 1, *B*) proved to have chromosomes of normal size for the species. The other (Fig. 1, *C*) has chromosomes of more than twice this size.

I have found similar differences in crosses between *Festuca arundinacea* and *F. pratensis*[4].

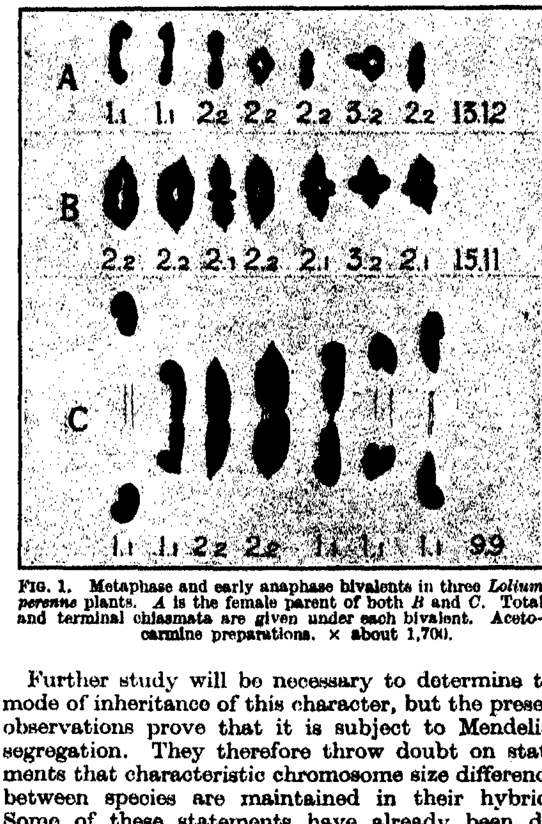



FIG. 1. Metaphase and early anaphase bivalents in three *Lolium perenne* plants. *A* is the female parent of both *B* and *C*. Total and terminal chiasmata are given under each bivalent. Aceto-carmine preparations. × about 1,700.

Further study will be necessary to determine the mode of inheritance of this character, but the present observations prove that it is subject to Mendelian segregation. They therefore throw doubt on statements that characteristic chromosome size differences between species are maintained in their hybrids. Some of these statements have already been disproved[5].

PERCY T. THOMAS.
John Innes Horticultural Institution,
London, S.W.19.
August 5.

[1] Darlington, *Amer. Nat.*, 66, 25 (1932).
[2] Darlington, *J. Genet.*, 21, 207 (1929).
[3] Jenkin, Welsh Plant Breeding Station Bull., *H*.12 (1931).
[4] Jenkin, *J. Genet.*, 28, 205 (1934).
[5] Upcott, *J. Genet.*, (in the press).

## Behaviour of Local *Drosophila melanogaster* during Late Larval Stage

DURING March 1935 a few local *Drosophila* flies which emerged from the soil and leaves of a millipede culture of Dr. N. F. Paterson were collected, and a culture was started. The stock proved to be of good viability; the flies were identified as *Drosophila melanogaster*. After the cultures had been kept for a few generations it was observed that the larvæ of this 'Witwatersrand' stock displayed an interesting difference in behaviour compared with the standard *D. melanogaster* cultures. During their late larval

stage, the larvæ of the latter, in order to pupate, creep up against the side of the culture bottle, whereas those of the 'Witwatersrand' stock only very occasionally behave in this manner, the great majority pupating on or even in the culture medium. We tentatively labelled this behaviour as 'positive hydrotropism' in contrast to the general 'negative hydrotropism' of *D. melanogaster*.

This positive behaviour apparently is the cause of the high percentage of wing abnormalities observed in our 'Witwatersrand' cultures, for when the flies emerge from the moist culture medium their wings often fail to unfold normally.

On April 14 this year, a random culture of our Witwatersrand stock was used for two series of selection experiments, a negative and a positive series. This culture had eight pupæ on the side of the bottle and between 150 and 200 on the culture medium. The negative series started with the eight pupæ removed from the side of the bottle, and the positive series with the pupæ on and in the culture medium. This method of selection was effected for each generation obtained. It follows that the number of parents each time for the negative series was very small in comparison with that of the positive series. This notwithstanding, the eight generations so far obtained for the negative series show an average of 38 negative pupæ per generation, and an average of only 10 negative pupæ for the six generations so far obtained for the positive series. The negative pupæ in the latter, after being counted, were always destroyed, and only the positive pupæ used; in the former only the negative pupæ were used.

It seems justified to conclude that this negative behaviour differs innately from the general positive behaviour of our Witwatersrand stock. Probably multiple factors are involved. This general positive behaviour again differs innately from the general negative behaviour of the standard stocks of *Drosophila melanogaster*.

Furthermore, several experiments have been made to cross our Witwatersrand stock with the standard *D. melanogaster* stocks, but without success.

It seems reasonable to conclude that our local Witwatersrand stock must belong to a geographic race of *D. melanogaster*.

We are indebted to Dr. Smart of the British Museum and to Dr. Paterson of the University of the Witwatersrand for the trouble taken to identify the flies, and also to Messrs. Paff and Bosazza for the photographs taken.

G. ELOFF.

Department of Zoology,
University of the Witwatersrand,
Johannesburg.
July 8.

## Creeping Movements of *Spirogyra*

THERE are several references in the literature to the movement and behaviour of masses of the alga *Spirogyra* when kept under water in a vessel. Hofmeister[1] described the unravelling of the filaments into wave-like hanks; this he believed to be due to the action of light. The same author, Oltmanns[2] and Langer[3] have also described the way in which the algal threads creep considerable distances up the sides of a containing vessel. Oltmanns suggested that the latter movement might be related to a secretion of mucilage from the cells. Langer showed that it was not a growth movement, and that it took place more rapidly and vigorously in the dark than in the light.

We have carried out a series of experiments to discover the effect of non-plasmolyzing solutions of various electrolytes and non-electrolytes upon the extent of these creeping movements in a species of *Spirogyra* tentatively named as *S. longata* Vauch. The method employed was the same for all experiments. A fixed quantity by weight of the alga was placed in a series of different solutions of electrolytes

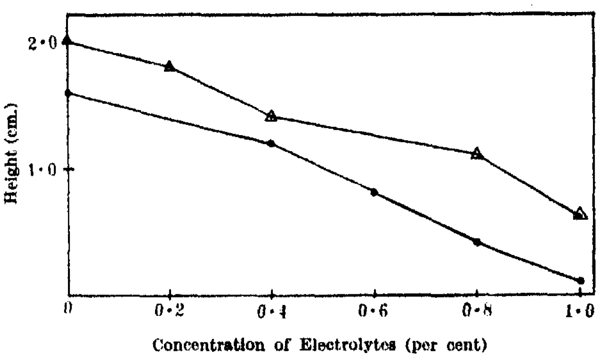



FIG. 1. Graph to show the relation between the extent of climbing and the concentration of electrolytes; —△—△—, potassium nitrate; —●—●—, sodium chloride.

and non-electrolytes in tap water, of concentrations ranging from 0·0 per cent to 1·0 per cent contained in similar test-tubes. The volume of the solution was constant for all the experiments. Since it was found that light had an inhibiting effect upon the creeping movements, the experiments were carried out in the dark. Measurements of the heights climbed above the meniscus of the solution were made after a period of twenty-four hours.

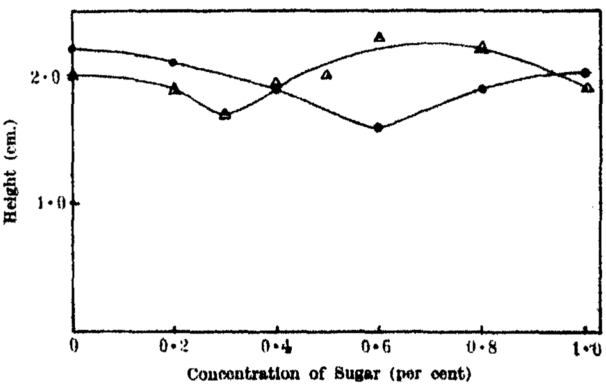



FIG. 2. Graph to show the relation between the extent of climbing and the concentration of non-electrolytes; —△—△—, sucrose; —●—●—, dextrose.

Using electrolytes such as sodium chloride and potassium nitrate, it was found that with increasing concentration of the electrolyte there was a corresponding decrease in the climbing effect. This is illustrated by Fig. 1.

Using non-electrolytes such as dextrose and sucrose, it was found that up to a certain definite concentration the behaviour was very similar to that obtained using electrolytes. Beyond this point, however, the effect was reversed and a further increase in concentration caused an increase in the extent of climbing (Fig. 2).

There seems to be a parallel between our observations on the effect of sugars upon the extent of climbing of these algal filaments and those of Maige and Nicolas[4] upon the effect of sugar solutions on the respiratory activity of various plant tissues. The latter showed that, during the first period of immersion in a sugar solution, a plant tissue showed a period of decreasing respiratory activity followed by one of increasing activity during the period of sugar penetration.

It is hoped to carry out further experiments to determine the effect of electrolytic and non-electrolytic solutions upon the rate of respiration of this alga, and also to develop a more accurate quantitative method of measuring the extent of the climbing phenomenon.

D. R. CHESTERMAN.
C. L. FOSTER.

Botanical Laboratory,
Woolwich Polytechnic,
London.
July 30.

[1] Hofmeister, Jahresber. ver. Vaterl. Naturkunde, Würtemburg, **30** (1874).
[2] Oltmanns, "Morphologie. u. Biologie der Algen". Band 1 (1922).
[3] Langer, "Folia Crypt.", 1 (1930).
[4] Maige and Nicolas, *Ann. sci. nat. Bot.*, Sér. 9, **12** (1910).

## The Electric Quadrupole Moment of the Nucleus $^{127}_{53}I$

THE hyperfine structures of many terms in the arc, as well as in the first spark, spectrum of iodine show deviations from Landé's rule[1]. As Murakawa has pointed out, the cause of this may be an electric quadrupole moment of the nucleus. The existence of such nuclear quadrupole moments was shown for the first time by Prof. H. Schüler and me in europium and cassiopeium[2]. The exact theory was given by H. Casimir[3]. In the case of iodine the frequent occurrence of deviations leaves no doubt that they are due to the same cause. Because the electronic structure of the terms is very complicated, most of them are not suited for a determination of the quadrupole moment. The best term is $5p^4\ 6s\ ^4P_{5/2}$ of I I measured by Tolansky. Its eigenfunction is approximately the product of the $6s$ eigenfunction and the eigenfunction of the $5p^4\ ^3P_2$ term of I II. The latter can be determined from the coarse structure, using the theory of intermediate coupling. By calculations analogous to those for bismuth[4] one gets from Casimir's formula and Tolansky's measurements a value of about $-0{\cdot}2 \times 10^{-24}$ for the nuclear electric quadrupole moment of iodine. That the sign is negative, one may infer also from the term $5p^2\ (^2D)\ 6s\ ^3D_2$ measured by Murakawa.

Two remarks should be added: first, Murakawa and Tolansky have determined the spin of iodine only by means of the interval rule. As we know it fails in most terms, the value of 7/2 cannot be excluded at present. Secondly, the structure of $^4P_{5/2}$ of I I was deduced by Tolansky under the assumption that the combining higher levels have no perturbation. His measurements on several lines seem to show that $^4P_{3/2}$ and most of the higher levels have deviations in the same direction as $^4P_{5/2}$. This would make the deviation in $^4P_{5/2}$ somewhat greater.

All one can say at present is, that the sign of the quadrupole moment is negative and that its value is smaller than $-0{\cdot}5 \times 10^{-24}$. The negative sign indicates that the charge distribution is flattened in the direction of the spin axis. It may be noted that the positive quadrupole moments now determined ($^{75}$As, $^{151,\,153}$Eu, $^{175}$Cp, $^{201}$Hg) have values ranging up to $5 \times 10^{-24}$, whereas the negative quadrupole moments ($^{63,\,65}$Cu, $^{127}$I, $^{209}$Bi) all have values[5] smaller than $-0{\cdot}5 \times 10^{-24}$.

*Note added in proof:* Recently, L. A. Strait and F. A. Jenkins[6] have shown by means of intensity measurements in the band spectrum that the spin of iodine is 5/2.

TH. SCHMIDT.

Astrophysikalisches Observatorium,
Institut für Sonnenphysik,
Potsdam.

[1] S. Tolansky, *Proc. Roy. Soc.*, **152**, 663 (1935); *Proc. Phys. Soc.*, **48**, 49 (1936); K. Murakawa, NATURE, **137**, 1030 (1936).
[2] H. Schüler und Th. Schmidt, *Z. Phys.*, **94**, 457 (1935); **95**, 265 (1935).
[3] H. Casimir, *Physica*, **7**, 719 (1935).
[4] H. Schüler und Th. Schmidt, *Z. Phys.*, **99**, 717 (1936).
[5] H. Schüler und Th. Schmidt, *Z. Phys.*, **98**, 430 (1936).
[6] L. A. Strait and F. A. Jenkins, *Phys. Rev.*, **49**, 635 (1936).

IN the preceding note, which the Editor of NATURE has been good enough to let me see in advance of publication, Schmidt, following Murakawa[1], suggests that the frequent occurrence of perturbations in terms of both the arc and spark spectra of iodine indicate a nuclear quadrupole moment. This may be correct, but as I have shown that at least in the spark spectrum[2] term interaction perturbation occurs, and in view of the complex electronic structures involved, it is very likely that the perturbations may be due to either of the above causes or possibly both, depending upon individual terms (that is, if a quadrupole moment is assumed to exist). This fact makes caution desirable and any calculation of the quadrupole moment can only be very approximate. Schmidt has been obliged to employ my measurements for the arc spectrum, and as I have previously pointed out, the structures in this spectrum are not so well resolved as in the spark spectrum. His calculation is therefore based upon a small deviation from the interval rule in which I was not able to prove whether more than one level was affected, so that the type of perturbation is uncertain.

Regarding Schmidt's suggestion that the spin may be 7/2, it may be pointed out that Murakawa[3] (spark spectrum), Tolansky[4] (arc spectrum, spark spectrum) and Lacroute[5] (Zeeman effect) all give 5/2. This value may be considered as certain, therefore, particularly in view of the Zeeman effect support.

The approximate quadrupole moment suggested by Schmidt is of course only tentative. I am engaged now in investigating the fine structures in the ultraviolet lines of the iodine spectra with the view of obtaining further data.

S. TOLANSKY.

Physics Department,
University of Manchester.
July 30.

[1] K. Murakawa, NATURE, **137**, 1030 (1936).
[2] S. Tolansky, *Proc. Phys. Soc.*, **48**, 49 (1936).
[3] K. Murakawa, *Sci. Pap. Inst. phys. chem. Res. Tokyo*, **20**, 285 (1933).
[4] S. Tolansky, *Proc. Roy. Soc.*, A, **149**, 269 (1935); *Proc. Roy. Soc.* A, **152**, 663 (1935); *Proc. Phys. Soc.*, **48**, 49 (1936).
[5] P. Lacroute, Thesis (Faculty of Science, University of Paris, Nov. 1934).

## Monomolecular Layers of Chlorophyll

IN order to study the properties of monomolecular layers of chlorophyll, a mixture of the modifications *a* and *b* in the proportion 3 : 1 (the proportion encountered in living plants), furnished by Prof. Stoll of Basle, was dissolved in ether or acetone. The solution was first added to pure water, to 0·01 normal and to 0·1 normal sulphuric acid. The relation obtained between area and pressure showed that a monomolecular layer actually is formed. No noticeable difference was found between the case of pure water and that of the acid, so that all the results can be incorporated in Curve I (Fig. 1). The spreading with a solution in acetone is recommended because on account of the greater volatility of the ether, traces of solid chlorophyll frequently remain at the opening of the pipette, making it more difficult to obtain reproducible values. Curve I corresponds to a film of the liquid type. The limiting area per molecule at zero compression is 124 A.$^2$, a value in satisfactory agreement with the value of about 133 A.$^2$, recently given by Hughes[1]. The small difference probably is due to impurities. At a pressure of about 26 dynes per cm. the film becomes polymolecular, the curve becoming a horizontal line.

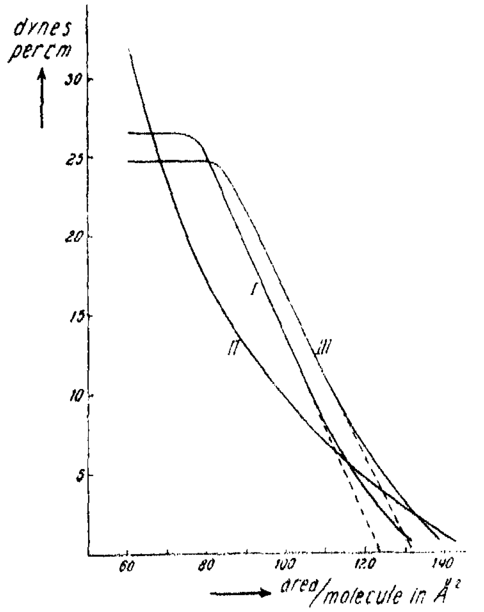



FIG. 1.

As the chlorophyll molecule possesses several double bonds, another curve was expected when spreading on an acid solution of potassium permanganate. This expectation proved to be justified. Curve II was obtained on a 1 per cent solution of potassium permanganate in 0·1 normal sulphuric acid. Over the whole range, but more particularly at small pressures, the film is more compressible than the films previously studied. It was impossible for us to measure the pressure where the film becomes polymolecular, this pressure being too high for registration by the instrument used.

Finally, the behaviour of chlorophyll on water containing carbon dioxide was studied. Great care had to be taken not to have the water oversaturated with carbon dioxide. Ultimately the experiments were carried out on water in equilibrium with carbon dioxide at one atmosphere. The results are contained in Curve III. The molecule appears to require a greater space under the influence of carbon dioxide, having a limiting area of 132 A.$^2$. That this is not due to the acid character of the solution is indicated by the experiments on sulphuric acid. The pressure required to make the film polymolecular is slightly less than in the case of pure water. Experiments with nitric oxide showed that this gas, which in its physical properties (solubility, etc.) strongly resembles carbon dioxide, has no effect.

In conclusion, I wish to express my thanks to Prof. E. Gorter in Leyden for the loan of a Langmuir trough of special construction, which enabled me to work in atmospheres other than air. Also I am much obliged to Prof. Prins for putting at my disposal the sample of chlorophyll and for suggesting the investigation on water containing carbon dioxide, to Dr. J. H. P. Jonxis for valuable advice concerning the technique of the experiments, to Dr. R. de L. Kronig for stimulating discussion and to Messrs. J. Vermeer and F. H. Robaard for their kind help in the performance of the measurements.

W. SJOERDSMA.

Natuurkundig Laboratorium
der Rijks-Universiteit,
Groningen.
July 30.

[1] A. Hughes, *Proc. Roy. Soc.*, A, 155, 710 (1936).

## Contact Potentials of Reversible Soluble Films of Lauric Acid

WHEN a nearly saturated solution of lauric acid in distilled water is placed in an Adam-Jessop film-pressure trough, the soluble adsorbed film may be compressed or swept in the same manner as an insoluble film of a higher fatty acid. However, the surface is rapidly replenished by diffusion from below, after sweeping, or the compressed film diffuses downward. In either case the reading of the film-balance returns to zero, in a period of about thirty minutes at 25° C. Similar effects have been noticed with benzopurpurin solutions[1] and with soap solutions[2]. Since the contact potential of solutions is proportional to the concentration of the surface-active solute, simultaneous contact potential measurements with a polonium-covered silver electrode on the above surfaces might be expected to yield potential-time curves nearly parallel to the force-time curves. Such proved to be the case, with the following notable differences.

Referred to a pure water surface as zero, the contact potential of a nearly saturated surface of lauric acid solution is −120 mv. Upon sweeping rapidly, the surface tension of the swept surface rises about five dynes and returns to its original value slowly. The surface potential immediately after sweeping rises to 0 mv., and falls rapidly to − 100 mv. in twelve minutes, whilst the surface tension has changed but a dyne per centimetre. This result is to be expected, since the first film to be formed by diffusion from below is necessarily dilute, and contributes but a small surface pressure, but a large change in surface potential. After twelve minutes the film becomes more close-packed, and the surface tension falls more rapidly, while the potential changes but slightly, in complete accordance with the results of Harkins and Fischer[3] on lauric acid films spread by the aid of a solvent.

Upon compression, the pressure may rise to so high as 25 dynes per centimetre, while the potential drops to − 200 mv. Both surface potential and surface pressure return to their equilibrium values in half an hour, the surface pressure falling very rapidly, due to solution of the compressed film, to a value of 6 dynes per cm., in two minutes. This is again in accordance with expectations, since Harkins and Fischer found that a highly compressed film of lauric acid lowers the surface potential about 80 mv. more than that of a dilute film.

These results indicate that (1) the time element is very important in the determination of surface tension of solutions of surface-active materials, (2) determinations of surface potentials by dynamic methods (such as Kenrick's jet method) are unsuited for examination of solutions of materials such as these which require considerable time for equilibrium in the surface.

The work is being continued on solutions of undecylic acid.

The results obtained by Bouhet[4] by an optical method may be mentioned as further evidence that sweeping a solution of a higher fatty acid removes the adsorbed film, the swept surface then having the physical properties of a pure water surface.

ROBERT T. FLORENCE.
ROBERT J. MYERS.
WILLIAM D. HARKINS.
Department of Chemistry,
University, Chicago.
July 31.

[1] Doss, *Current Sci.*, 4, 405 (1935).
[2] McBain and Wilson, private communication, and *J. Amer. Chem. Soc.*, 58, 379 (1936).
[3] *J. Chem. Phys.*, 1, 852 (1933).
[4] *Ann. Phys.*, x, 15, 5 (1931).

## Dissociation Pressure of Copper Sulphate Pentadeuterate

J. R. PARTINGTON and K. Stratton[1] have found by a tensimetric method the dissociation pressure of copper sulphate pentadeuterate to be 6·655 mm. Hg at 25° C., and 9·285 mm. Hg at 30° C. One of us, in collaboration with H. Perpérot[2], has constructed a tensimeter by means of which he ascertained in a preliminary experiment that the dissociation pressure of copper sulphate pentadeuterate is lower than that of the pentahydrate. Continuing this research, we have modified the original tensimeter so that the pressures are now measured by means of an ordinary shortened manometer instead of a differential one, the new results being as follows:

| | | | | | |
|---|---|---|---|---|---|
| ° C. | 20 | 30 | 40 | 50 | 60 |
| mm. Hg | 4·4 | 9·9 | 21·0 | 42·1 | 80·9 |

For 25° the value of 6·5 mm. Hg is found by interpolation.

The pressures obtained are in good accord with those measured by Partington and Stratton, giving in addition a wider range of temperature. The value published in collaboration with H. Perpérot[2], which is mentioned by F. T. Miles, R. W. Shearman and Alan W. C. Menzies[3], was not intended to be exact, as is seen from the fact that it was rounded off to whole units and mentioned only in passing in a paper describing the apparatus, and is decidedly a little too low, whereas the measurements of Miles, Shearman and Menzies lead, on the contrary, to dissociation pressures a little too high, if we understand these authors rightly.

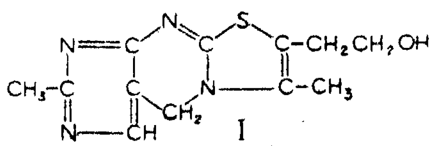
The aim of the communication published with H. Perpérot was not to give a precise value of the dissociation pressure of copper sulphate pentadeuterate, but to show only that this pressure is lower than that of the pentahydrate, which is corroborated by experiments of the authors quoted.

F. SCHACHERL.
O. BĚHOUNEK.
Laboratory of Inorganic Chemistry,
Masaryk University,
Brno, Czechoslovakia.
August 1.

[1] NATURE, 137, 1075 (1936).
[2] *J. Phys. et le Rad.*, vii, 6, 439 (1935).
[3] NATURE, 138, 121 (1936).

## Synthesis of Thiochrome

THE formation of thiochrome by oxidation of aneurin (vitamin $B_1$) with alkaline potassium ferricyanide was first reported in these columns[1]. Continuation of our synthetic work[2] has resulted in the synthesis of thiochrome. 2-Methyl-4-chloro-5-chloromethylpyrimidine, synthesized from 2-methyl-4-hydroxypyrimidine-5-acetic ester, was condensed with 2-amino-4-methyl-5-β-hydroxyethylthiazole. The condensation product (I) proved to be identical with thiochrome prepared from aneurin; the melting point of both substances was the same (225°–226°) and the melting point of the mixture showed no depression.



I

The intense blue fluorescence shown by thiochrome appears to be a property of the condensed ring system present in the molecule, for we have prepared other compounds of this type, all of which have a similar fluorescence. This synthesis affords independent proof of the structure of aneurin, the synthesis of which has just been reported by Williams and Cline[3].

Full details of the work will be published elsewhere.

F. BERGEL.
A. R. TODD.
Medical Chemistry Department,
University, Edinburgh.
Aug. 26.

[1] Barger, Bergel and Todd, NATURE, 136, 259 (1935).
[2] Bergel and Todd, *ibid.*, 138, 76 (1936).
[3] *J. Amer. Chem. Soc.*, 58, 1504 (1936).

## The Amylase System of Rice Grain during Ripening and Germination

THE formation and properties of α- and β-amylases in germinating grains have been frequently studied by many investigators. Some workers[1] believe that dormant grains contain only β-amylase which increases during germination, while α-amylase appears only during sprouting. Others[2] consider that the increase in amylolytic activity during germination is not a fresh enzyme formation, but is due to an activation by an activator of organic nature,

'amylokinase', which arises during the process of germination, or to an increase in the soluble part of the amylase, especially in the case of the β-component, which increase is based on proteolytic decomposition. Our researches on the amylolytic changes during ripening and germination of rice grains have thrown fresh light on this important question. The results thus far obtained may be briefly summarized as follows.

The rice grain contains both α- and β-amylases, which are differentiated by their hydrolysis on amyloamylose, according to the method introduced by Samec and Waldschmidt-Leitz[3]. These two amylases are further differentiated by their differences in *p*H optima, the α- and β-amylases having their optima at *p*H 7·0 and 4·6 respectively. At their optimum *p*H, they behave like pure α- and β-amylases in their hydrolysis of amyloamylose. In the case of the amylase the optimum *p*H of which lies at *p*H 7·0, the iodine colour end-point (violet) was reached without any measurable maltose formation. This observation demonstrates for the first time the occurrence in plants of an amylase of *p*H optimum 7·0, which in the early stages of starch digestion yields no reducing groups.

These two enzymes are present in the dormant seed, and exist largely in the insoluble condition, so that they cannot be extracted with water, but they can be obtained in an active state by extraction with phosphate buffer ($M/15$) at *p*H 7·0. The α-amylase becomes inactive (in the sense that it cannot be extracted with water) as ripening advances, and again becomes active during germination. In the light of these findings, it can be said that the view put forward by Ohlsson and co-workers, that the amylase arises only during the germination of grains, is untenable. Further work on the behaviour and nature of these enzymes during germination and storing, their distribution in the seed and their relation to the cooking quality of rice is in progress.

K. VENKATA GIRI.
A. SREENIVASAN.

Department of Biochemistry,
Indian Institute of Science,
Bangalore.
July 22.

[1] G. Nordh and E. Ohlsson, *Z. physiolog. Chem.*, **204**, 89 (1931–32); E. Ohlsson and C. E. Uddenberg, *ibid.*, **221**, 165 (1933); E. Ohlsson and O. Edfeldt, *ibid.*, **221**, 174 (1933).

[2] E. Waldschmidt-Leitz, M. Reichel and A. Purr, *Naturwiss.*, **20**, 254 (1932); K. Myrback and S. Myrback, *Biochem. Z.*, **258**, 158 (1933).

[3] M. Samec and E. Waldschmidt-Leitz, *Z. physiol. Chem.*, **203**, 16 (1931).

## Points from Foregoing Letters

WHEN beryllium is bombarded by fast neutrons, a radioactive substance is produced of half-period about one second. New experiments by Dr. T. Bjerge show that it is a gaseous substance, probably helium of atomic mass six or five. The energy distribution of the β-rays (electrons) emitted by this radioactive gas has been measured by Dr. T. Bjerge and Dr. K. J. Broström, and agrees with the view that the electrons arise during the transformation of helium atoms of mass six into lithium atoms of the same atomic mass.

The probability for the production of secondary electrons when a fast primary electron passes through various thicknesses of matter has been calculated by H. J. Bhabha and Dr. W. Heitler. A primary electron of $2 \times 10^9$ electron volts energy, passing through a thickness equivalent to 1·6 cm. of lead, produces, on the average, two positive and two negative electrons, with energies greater than $2 \times 10^7$ e.v.

M. S. Bartlett discusses further aspects of the uncertainty principle applied to time, and conceives that, in relation to an ideal time defined in terms of the number of interactions that take place, our observable time may slow down, as the universe approaches equilibrium. Such a 'slowing down' of observable time would be equivalent to an expanding universe or a decrease in the velocity of light.

The occurrence of chromosomes of double normal size in a male sterile specimen of the perennial rye-grass, *Lolium perenne*, is described by P. T. Thomas. The mode of inheritance indicates that chromosome size is subject to Mendelian segregation.

*Drosophila* cultures derived from flies collected on the Witwatersrand and bred by Dr. G. Eloff, although identified as *D. melanogaster*, nevertheless show a remarkable innate difference in behaviour in that during late larval stage, contrary to the general behaviour of the standard *D. melanogaster* cultures, the larvæ stay on or even in the culture medium in order to pupate; also, crosses between the two types of stocks are sterile.

*Spirogyra*, in the dark, climbs up the sides of the containing vessels. Solutions of electrolytes such as sodium chloride or potassium nitrate up to one per cent in concentrations—which do not produce collapse due to loss of water (plasmolysis)—are found by D. R. Chesterman and C. L. Foster to reduce the creeping. With non-electrolytes the behaviour up to a definite point is similar; beyond this point it is reversed. The authors suggest that these results may be related to effects upon the respiratory activity of the algal cells.

From measurements of the iodine hyperfine structure Dr. Th. Schmidt concludes that the iodine nucleus has a negative electric quadrupole moment smaller than $-0·5 \times 10^{-24}$. The negative sign means that the charge distribution is flattened in the direction of the spin axis. Dr. S. Tolansky points out that the perturbations upon which Dr. Schmidt's calculations are based may have a different origin, and therefore the approximate quadrupole moment suggested can only be considered tentative.

From experiments with monomolecular surface films of chlorophyll, W. Sjoerdsma finds an area per molecule of 124 square Angstrom units. Under the influence of carbon dioxide, the chlorophyll molecules appear to require a greater space (132 A.$^2$).

The rate of change in surface pressure and in the contact electrical potential when the surface of a solution of lauric acid is swept clean of its adsorbed film and the lauric acid allowed to re-accumulate at the surface, by diffusion from the interior of the solution, have been determined by R. T. Florence, R. J. Myers and Prof. W. D. Harkins. They point out that possible variations due to the time factor must be taken into account when measuring the surface tension or surface potential of such solutions.

# Research Items

## Social Origins in India

Two things in the social organization of India immediately strike the observer, it is pointed out by K. P. Chattopadhyay (*J. Asiat. Soc. Bengal. Letters*, 1, 1935) in discussing peculiarities of caste in relation to early racial movement. One is the peculiar system of endogamy combined with exogamy running through the whole system, the other is that the giving of food and drink, or acceptance thereof, between different social groups depends on certain ideas of purity associated with the groups. In the course of further discussion, it is also noted that theories of caste, which have been put forward, tend to ignore local differences. Applying to conditions in India the results of an analysis of culture and the effects, issuing in rivalry and group isolation, presumably produced by racial migrations, it would appear that there were not two, but three cultured peoples who contended for mastery in India and built up the caste organization. Of two early streams of culture bringers one was a fisher folk, who were acquainted with, or later acquired, knowledge of iron and practised a rude form of agriculture, comparable to jhuming, but not terracing or systematic irrigation. Another people worked copper, silver and gold and practised terraced irrigation with hoe cultivation. Cattle were valued for meat only. A third stream of later date is associated with cattle for dairy work, but not for plough cultivation. This last-named employment of cattle is associated with another people, who sometimes preceded and sometimes followed the dairy folk. With this people and the people of the hoe cultivation is a tradition of origin from, or occurrence of, incestuous unions of brothers and sisters. The fisherfolk practised burial, at first in the house, but the hoe culture people practised cremation. In some instances the burial people, after being submerged, again recovered and then a formal, but not actual, cremation was made to precede burial. Alliances between different groups and bitter struggles appear to have taken place before equilibrium was reached and the caste system evolved.

## Hormones and Evolution

IN a communication recently presented to the Royal Anthropological Institute, Dr. S. Zuckerman discusses the evidence bearing upon the relation of hormones to the evolutionary problem (*Man*, 1936, August). How far, it is asked, is the endocrine system responsible for physical and psychological characteristics; what value is to be attached to Bolk's view of the endocrine mechanism as one through which man has become a fœtalized primate? Does the so-called hormone theory of evolution in fact reveal some novel evolutionary mechanism? Recent research has largely justified the *a priori* view that all the characteristics of the organism are moulded by an endocrine mechanism to subserve the developmental integration of the various bodily systems, in order that the correlated action of an organism as a whole should be possible. At the same time, physical and psychological characters are dependent on an enormous number of factors besides hormones. There is not the slightest direct experimental evidence in support of the view that different individuals and different racial types possess distinctive types of endocrine balance. We do not yet possess the data for making definite interpretations of racial types in terms of hormones. There is a correspondingly unfortunate lack of evidence in Bolk's view of the fœtalization of man, and within the order of primates an orderly process of fœtalization cannot be recognized. Yet it is not unlikely that human evolution may have proceeded by a series of changes in the endocrine complex; but we are defeated in any attempt to find in this conclusion some novel understanding of the evolutionary process. The endocrine complex, like any other character, is genetically determined, and we have no knowledge that the effect of its response to environmental influence is transmitted to a succeeding generation. The available facts of endocrinology provide no measuring rod by which to estimate the divergence between different racial types.

## Sickness Absence and Labour Wastage in Industry

AN attempt has been made by the Industrial Health Research Board of the Medical Research Council, by an investigation of data furnished by several organizations, to obtain some sort of datum line by which absenteeism due to sickness and wastage by lapsing from employment may be evaluated (Report No. 75. London: H.M. Stationery Office. 1*s*. 3*d*. net). This Report is divided into two parts, sickness being dealt with by May Smith and Margaret Leiper in Part i, and labour wastage by Major Greenwood and May Smith in Part ii. The measurement and incidence of sickness absence in clerical work and light organizations are considered, and in two large groups examined the rates for men are 3 days and 4½ days respectively, and for women 4 days and a little more than 6 days, per year. The crude rates obtained are subject to various fallacies, for example, long periods of absence due to serious illness of two or three workers may upset any simple arithmetical ratios obtained. Respecting labour wastage, the problem to be solved is discussed, the crude wastage rate is considered, and an 'industrial life table' is constructed. The actual labour wastage in two organizations is then studied, and various interesting features emerge from the analysis. Finally, suggestions are made for recording and analysing sickness absenteeism and labour wastage.

## False-killer Whale in Scotland

Two papers dealing with the recent stranding of false-killer whales (*Pseudorca crassidens*) in Britain record an exceptionally interesting occurrence (*Scottish Naturalist*, 1936, p. 93). The greatest stranding, of forty-one individuals, took place in the Tay Estuary on November 27, 1935; but odd occurrences of single individuals or of small groups up to eleven in number which took place between November 16 and December 10, and ranged along the east coast from Norfolk to Montrose, show that a considerable movement must have been taking place in the North Sea. Prof. A. D. Peacock and his collaborators have recorded minutely the measurements and other striking characters, of the Carnoustie school of whales, reserving more detailed studies for later publication.

### Hydroids from the West Indies

DR. EUGÈNE LELOUP in his monograph "Hydraires Calyptoblastiques des Indes Occidentales" (Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Deuxième Série, Fasc. 2, 1935) describes collections made by P. Wagenaar Hummelinck on his voyage in 1930 to the West Indies, especially to the Islands Bonaire, Curaçao and Aruba. With these are specimens taken from floating Sargasso weed in the Atlantic and a series of calyptoblastic hydroids dredged at Dry Tortugas (Florida), the last sent by Dr. Waldo L. Schmitt, Smithsonian Institution, U.S. National Museum. Among these hydroids, four are found for the first time in the Atlantic: *Halecium dyssymetrum* from Florida, hitherto only known from the East Indies, and for the first time recorded since the type specimens were described; *Synthecium cylindricum* var. *pusilla* on Sargassum weed, previously known only from the Pacific; *Laomedea kincardi* and *Sertularella minuscula* from Bonaire, previously known only from the Pacific and from the Indian Ocean respectively. Several other forms are reported for the first time since the discovery of the type specimens, and many are new records for certain localities. Among the fifty species and varieties described there are three new to science.

### Principal Rots of English Oak

A SMALL volume on this subject by Messrs. Cartwright and Findlay of the Forest Products Research Laboratory has been issued by the Department of Scientific and Industrial Research (London: H.M. Stationery Office, 1936). Existing knowledge and recent work carried out at the Laboratory on the principal fungi causing decay in English oak are detailed and illustrated. One of the fungi attacking the tree is known as the beef-steak fungus, and the attack increases the value of the timber, producing the so-called 'brown oak' which fetches a higher price and is much valued in France. The report states that the general measures for controlling the attack of heart-wood of trees by fungi are the prevention, by sylvicultural methods, of the formation of large branches which may die by becoming infected with fungi. Attacks of this nature are serious in parts of England; but in some of the best managed oak forests in France are unknown. Probably one of the best preventives is to keep the young plantations dense and thin lightly in the earlier stages of growth; and to grow oak in mixture, preferably when possible with its natural companion beech. The economic aspects of the various rots of felled timber are dealt with; and a final section treats of the stains and discolorations of oak wood such as 'golden oak', yellow, grey stains and chemical stain.

### Composts for Mushroom Growing

THE food requirements of the common mushroom have not yet been determined with accuracy, though a considerable amount of success has been obtained with composts of a more or less synthetic nature. Mr. G. Paterson-Hart has described a number of such mixtures (*Gard. Chron.*, Aug. 1, 1936). Soya bean compost, a mixture of bean straw with tree leaves, and sphagnum moss impregnated with stable drainage, have proved fairly successful. Straw, covered with soil, and impregnated with salt solution, has grown mushrooms, whilst grass cuttings, ditch clearings, tree leaves and straw, when mixed and covered with mould, make quite a successful bed. The problem would seem to be to identify the common factor in all these different mixtures, and also in such varying habitats as stable sand dunes and heathy woods, where the fungus grows naturally.

### Air Conditioning in Living Rooms

A SIMPLE device for humidifying air to a degree best suited for breathing has been developed by the A.E.G. Co. of Berlin and is described in *A.E.G. Progress*, No. 2, 1936. The water to be evaporated is contained in a tank in which rests a frame with capillary pads consisting of absorbent blotting paper overlapped and sewn together. These pads are completely saturated with water and can be readily replaced. The evaporation of the water is accelerated by an electric fan built into the back wall of the protective case. With a relative air humidity of 50 per cent and a temperature of 68° F., the apparatus evaporates about 7 oz. of water per hour. It is found that one filling of water is sufficient for eight hours operation. The quantity of water evaporated varies to a certain extent with the condition of the air, the rate increasing with the heat and the degree of dryness. The apparatus has been found useful in living rooms where the atmosphere gets close, in nurseries, in offices where smoking is allowed, as well as in hotels, hospitals, etc. In countries where a dry and warm summer climate has already rendered the electric fan indispensable, the apparatus is particularly useful, producing a refreshing and vitalizing effect.

### The Nitrous Oxide Molecule

ALTHOUGH the molecules of carbon dioxide and nitrous oxide are both linear, it is known that one is symmetrical and the other unsymmetrical:

$$O = C = O \qquad N \leftarrows N = O.$$

Cheng E. Sun and Ta-You Wu (*J. Chinese Chem. Soc.*, 4, 340; 1936) show that this difference may be explained by the energy contents of the two molecules. They used the semi-empirical method of Eyring and found that the unsymmetrical form of nitrous oxide has a lower energy content than the symmetrical form, whilst the reverse is the case with carbon dioxide. Although the method is only approximate, the differences between the energies of the two forms are sufficiently large to be significant.

### Recent Advances in Enzyme Chemistry

IN a summary of recent work on enzymes, Prof. E. Waldschmidt-Leitz (*Chemistry and Industry*, 55, 620; 1936) points out that crystalline enzymes (urease, pepsin, trypsin, etc.) are all proteins, yet the reactions show that an enzyme cannot merely be a protein, the existence of a specific active grouping being necessary for enzyme differentiation. An iron porphyrin complex is the active group of liver and pumpkin catalases as well as of the peroxydase of horse-radish. A low molecular weight flavine compound, vitamin $B_2$, when connected with a protein carrier, becomes a true enzyme, the yellow respiratory ferment. The 'two-affinities' theory of von Euler, according to which an enzyme must be capable of reacting with its substrate at two distinct points in the molecule, is shown to be most defensible. The action of activators (for example, trypsin by enterokinase) is probably due to intermediate compound formation. Many other interesting features of enzyme chemistry are considered in the article.

# Plankton Research

A SPECIAL plankton meeting was held by the International Council for the Exploration of the Sea in May 1935. The reports are published in vol. 95 of the *Proceedings* recently published. The papers by F. S. Russell and A. C. Hardy give an excellent picture of some aspects and methods of plankton research. H. Höglund and S. Landberg report on investigations upon photosynthesis of phytoplankton by constant illumination, and B. Schulz on hydrographical problems.

In Russell's paper, all those studies of zooplankton are reviewed which are concerned with: (1) the distribution and abundance of the plankton in the open ocean and (2) in the coastal waters; (3) the relation of the animals with animate and inanimate environments and the causes of their fluctuation in abundance. A table based on data of various workers brings out facts of great interest, such as the greater number of cold-water species in the south as opposed to the north, the phenomenon of bipolarity of some planktonic species, the small number of purely subantarctic species of copepods, and differences between the faunas of the different oceans. The bearing of the plankton distribution upon the interpretation of hydrographical data is stressed. The author himself, in a notable study of the *Sagitta* population at Plymouth, has found that *S. elegans* is an indicator of Atlantic water and *S. setosa* of Channel water. Another important aspect dealt with is the relations between the plankton and the fish. "If correlations can be shown to hold consistently for a number of years it should be possible to predict certain conditions in the fisheries." Several other problems are discussed and attention directed to the need for further studies of life-histories and habits, food supply, and for more experimental work.

Hardy gives a preliminary account of experiments made by him and the research staff of the Oceanographic Department in Hull in the charting of the North Sea plankton. A new instrument has been used for the survey, the 'continuous plankton recorder'. This is an ingenious torpedo-shaped machine provided with a system of planes and a shock absorber, and inside with two bandings of filtering gauze arranged to wind off two rollers and to pass together into a tank of formalin. By means of a winding mechanism, for every mile of sea through which the instrument is towed a fresh section of gauze samples the plankton. Taken out of the preservative chamber, the number of organisms per division of silk can be estimated. With the co-operation of different steamship lines a programme of surveying was started in 1932. "The main objects of the survey are to chart the broad monthly changes in the density of the plankton along a series of lines across the North Sea . . . to correlate as far as possible the seasonal and yearly variations observed with changing hydrological and meteorological conditions on the one hand, and with fluctuations in the fisheries on the other, and in addition to provide extensive material for the study of ecological relationships between different members of the phyto- and zooplankton." Some promising examples of the results are given showing changes in the production of the phytoplankton and zooplankton in different seasons on the same line, and differences on different lines at the same periods.

B. Schulz reviews the results of hydrographical observations in the Kattegat in August 1931. Very numerous and detailed records were taken simultaneously during a week from five ships (one Danish, one Swedish, one Finnish and two German) lying within a relatively small area. The author summarizes the results as showing that "unperiodical changes of the hydrographical conditions (currents, temperature, salinity) at the points of observation were quite considerably bigger than one would have expected according to our previous knowledge and views. The mixing processes resulting in the Kattegat from the outflow from the Baltic Sea and the inflow from the North Sea are far more intensive and turbulent than was formerly supposed."

# The Radio Exhibition at Olympia

THIS year's National Radio Exhibition at Olympia is the eleventh annual event of its kind, and the Radio Manufacturers' Association is to be congratulated on its successful organization of the show, which offered more comfort for the visitor than in the past, and also maintained the spirit of novelty which is so characteristic of this event. For the most part, the exhibition was a display of the vast variety of wireless receiving sets, which are now available to meet practically all the many and differing demands of the broadcast listening public. On a much smaller scale, the needs of the specialist and technically-minded enthusiast and experimenter are catered for, in the way of special components and of receiving sets for use abroad or for general experimental work. The impression was definitely conveyed that this vast industry of some twelve years standing is now firmly planted on its feet; with only a few exceptions, the names of the exhibitors are now almost common household words among the general public.

The general broadcast receiving set of to-day is similar in all essential features to its predecessor, various improvements in detail having been effected where in the past the control of the set has been difficult or inconvenient, or the performance has left something to be desired. It has undoubtedly improved in reliability due to the advanced testing methods adopted by the industry, and this is a feature that many members of the public will greatly appreciate.

The receivers now fall broadly into the two classes, comprising the straight amplifier and detector combination and the supersonic heterodyne type, and in each form separate models are generally available for either battery operation or for connexion to the electric supply mains. In one or two cases a spectacular

method of visual tuning has been incorporated in the receiver. The great advance that has taken place in this year's sets, however, is the extension of the tuning arrangements to cover the short wave broadcasting bands. The title 'all-wave' tuning is generally applied to such receivers, but in only one or two cases can the set be tuned continuously from a wave-length in the region of 10–15 metres up to nearly 600 metres. The majority of the 'all-wave' receivers cover the short wave broadcasting bands only, there being gaps in the wave-length scale, where, at present, there are no transmissions of interest to the broadcast listener. Even with this restriction, however, it is necessary to provide the receiver with four separate wave-length bands, selected by an extension of the usual wave-change switch.

The production on a manufacturing scale of such a set in which the tuning on each band is controlled by the same knob, with a pointer reading on scales calibrated directly in wave-lengths, is a technical achievement of considerable merit. It is evident that, following upon the use of short-waves for Empire and other long-distance broadcasting, the reception of such short-wave programmes has now successfully passed beyond the experimental stage.

The other great feature of the exhibition was the demonstration of the present stage of television with the aid of the special test transmissions from the B.B.C. experimental station at Alexandra Palace. At this station separate television transmitters have been installed by the Baird Television Co. Ltd. and the Marconi E.M.I. Television Co. Ltd., and during the course of the radio exhibition these installations were used on alternate days for broadcasting a television programme. The accompanying sound was radiated from a separate transmitter installed by the B.B.C. The wave-lengths in use are 6·67 metres (frequency 45 megacycles per second) for the vision and 7·23 metres (41·5 megacycles per second) for the sound.

The daily programmes were received at the exhibition and demonstrated to the public on a number of receiving sets, the makers of which were not stated. Although naturally the interest displayed by large numbers of visitors precluded the study of the results for more than a short period, the demonstration was sufficient to indicate that the successful reproduction of a television programme broadcast from a station ten miles away is a present-day achievement. For the first time, the public has been enabled to see, as well as hear, the announcer in the studio and a well-known broadcasting singer. The majority of the programme comprised the transmission of sound-films, either constructed specially for this demonstration or extracted from standard news and entertainment films.

In the exhibition hall itself several firms displayed sets suitable for receiving these transmissions, although these were unpriced and were not in operation. The output on the vision side of these sets operates a cathode ray tube of unusually generous dimensions, the largest having a bulb of 22 inches diameter, the luminescent screen providing a picture area of 17½ in. × 13½ in. In most cases it is claimed that these receivers will give satisfactory results on the transmissions from the Alexandra Palace at distances up to 40 miles. In accordance with the recommendations of the Television Advisory Committee, all such receivers are arranged to reproduce the vision programme whether this be emitted on the Marconi E.M.I., or the Baird system.

It would thus appear that the time is ripe for the carrying out of practical and widespread tests of the possibilities of radio-television in Great Britain, although it is natural that some time must elapse before the technique has been simplified and the manufacturing costs reduced to such a point as to make television reception in the home available to the majority of the general public. R. L. S.-R.

# Valency and Molecular Structure

By Prof. R. F. Hunter and Prof. R. Samuel

THE connexion between the numerical valency exhibited by an atom and the number of its outside electrons, which prevailed in certain pre-wave mechanical theories of valency and in the theory of Heitler and London, appears to us of fundamental importance to the problem. It cannot be fortuitous that iodine, for example, which possesses two *s*- and five *p*-electrons, exhibits odd covalencies of 1, 3, 5 and 7. Nevertheless, this relationship appears to have been lost sight of in the chemical theories of Lowry, Sidgwick, and others on account of the conception of co-ordinate covalency, in which only electrons belonging to one of the atoms concerned are made responsible for chemical combination. This conception appears to connect these theories with the theory of molecular orbitals (Herzberg, Lennard-Jones, Mulliken) in that chemical linkage is ascribed to the bonding power of single independent electrons, while the formation of pairs is an essential feature of the theory of Heitler and London.

Since valency is an ambiguous term, it is necessary to distinguish clearly between energetical questions and numerical chemical valency. While bond energy may vary from molecule to molecule, the valency number indicates the possibilities for chemical reaction and is a property of the free atom or radical. The maximal valency of the halogens is 7, but since this necessitates the fission of the $s^2$ group, considerable energy, which decreases with rise in atomic number, is required, so that heptavalency obtains with oxygen in $Cl_2O_7$ and with fluorine in $IF_7$. Although we are here mainly concerned with experimental facts, it is necessary to make brief reference to the wave mechanical interpretation of bonding power.

*Wave Mechanical Considerations*[1].—It is true that in the exchange integral (in formula 11 of Heitler and London's original paper),

$$E_{12} = \int \left( \frac{2\varepsilon^2}{r_{12}} + \frac{2\varepsilon^2}{R} - \frac{\varepsilon^2}{r_{a_1}} - \frac{\varepsilon^2}{r_{a_2}} - \frac{\varepsilon^2}{r_{b_1}} - \frac{\varepsilon^2}{r_b} \right) \frac{\psi_1\varphi_1\psi_2\varphi_2}{2} \, dr_1 \, dr_2,$$

the attraction (negative sign) is produced by those terms which are caused by the terms of the potential representing interaction between one nucleus and one electron. The pure interaction between the electrons themselves ($\epsilon^2/r_{12}$) gives an effect of opposite sign, and is antibonding. This, however, cannot be interpreted as proof of the bonding power of the single electron. That the whole expression $E_{12}$ is called the exchange integral is not due to this term containing $r_{12}$ representing the interaction of the electrons between themselves, but to the fact that the mere existence of the quantity $E_{12}$ is connected with the use not of the wave function $\psi_1\varphi_2$, but of the wave function $\psi_1\varphi_2 \pm \psi_2\varphi_1$. This, in its turn, is the direct consequence of the degeneracy produced by the identity of the electrons.

Thus, the relation of the electron pair bond theory to the single electron bond theory in the method of molecular orbitals becomes quite clear. In the latter, the same terms appear even without the repulsion term with $r_{12}$, but the appearance of the double product $\psi_1\varphi_1$ is produced here not by the use of the function $\psi_1$ but of the function $\psi_1 \pm \varphi_1$. In other words, it is introduced by the identity of the nuclear fields.

From the point of view of a theory of valency, this is of course purely incidental. Chemical linkage is not confined to atoms of the same element, and attempts have therefore been made to explain this by means of a pseudo degeneracy of unequal nuclei, if the interaction is of the order $E_\psi - E_\varphi$, meaning that the valency of an atom not only as regards bond energy, but also in the numerical sense, should depend on the partner, and the greater the difference in the nuclear fields the smaller must be the distance between them to bring about this bonding effect.

The latter point is certainly empirically untrue as seen, for example, from the known diameters of oxides of the first short period. Regarding the first point, since we are not concerned here with the development of a perturbation method of calculation but with a theory of valency, it seems obvious that the valency number of an atom cannot depend on the partner with which it combines, other than in the energetical sense. Indeed the method of molecular orbitals gives incorrect results with regard to the products of dissociation of a molecule, due to neglect of the wave mechanical interaction of the electrons.

Since dissociation is the converse of molecule formation, this confirms our view that the method of molecular orbitals describes the electronic configuration and term system of the completed molecule but is not a theory of valency. Actually, it is unable to distinguish in itself between terms of attraction (molecule formation) and terms of repulsion (elastic collisions), and only becomes a theory of valency by the introduction of a postulate which identifies non-premoted with bonding electrons and premoted ones with anti-bonding. From new spectroscopical data it becomes increasingly evident, however, that this postulate can no longer be maintained.

*Spectroscopical Evidence*[4].—The number of molecules in which it is possible to correlate the molecular terms with those of the separated atoms has increased considerably of late. Particular interest is attached to the halides and oxides of the second group, in which it has been shown that the ground level of the molecule is correlated, not to an unexcited halogen or oxygen atom plus an unexcited metallic atom with the configuration $s^2\ ^1S$, but to an excited metal atom with the configuration $sp\ ^3P$. This now receives confirmation from some ten examples, the most striking of which are those in which the metal possesses high excitation energy. Whenever an excited molecular term appears in which the bond energy is higher than in the ground level, it is correlated to the so-called anomalous terms of the metal atom, in which both the original $s$-electrons have been simultaneously excited, showing that whenever a second linkage is formed (as in BeO and MgO), it occurs only in the presence of two $p$-electrons. Whenever an odd-electron molecule is formed (BeF and CaF), the partial removal of the odd electron increases the bond energy, showing that the unpaired electron is always disturbing.

Both these points receive confirmation from molecules of other types. NO, PO, and AsO, and also SiF and SnCl, all show the disturbing influence of the unpaired electron. On the other hand, molecules such as AlO and GaO are formed by the combination of oxygen with unexcited metal atoms of the configuration $s^2p\ ^2P$, but the molecular term, of which the bond energy is much higher than in the ground level, is formed by the combination of oxygen with metal atoms of the configuration $sp^2\ ^4P$; the second linkage again occurring only after fission of the $s^2$ group. These results are incompatible with the theory of the co-ordinate link and show the antibonding character of the closed helium-like $s^2$ group, which constitutes the 'lone pair' in the majority of cases. While the pair bond conception of valency gives a straightforward and consistent interpretation of these results, the theory of molecular orbitals, on account of its premotion postulate, would predict that molecules such as BeO and BeF would be formed by unexcited metal atoms because they possess an excess of non-premoted (and therefore bonding) electrons.

The difference between an electron pair bond theory of valency and that of molecular orbitals finally finds its expression between localized and non-localized electrons in polyatomic molecules. The first experimental evidence in this connexion has been obtained from a complete vibrational analysis of the band spectra of $SO_2$ and $SeO_2$. These results show that the harmonic vibrations, for example, of SeO in its unexcited and excited states, agree closely with two symmetrical valence vibrations of unexcited and excited $SeO_2$; the energy of electronic excitation being almost identical in the two molecules and the factor of anharmonicity of the ground states, which could not be accurately determined for $SeO_2$, appears at least to be of the same order. Furthermore, the heat of dissociation of $SeO_2$ into gaseous atoms is about twice that of SeO. The molecular constants of $SO_2$ bear the same relationship to those of SO, and the continuous absorption spectra of halides and oxyhalides of sulphur show that the bond energies of the S–Cl, S=O, and S=S bonds are approximately of the same order in widely differing molecules such as SO, $SCl_2$, $SOCl_2$, $S_2Cl_2$, and $SO_2$.

Each of the bonds in polyatomic molecules of this type appears to be localized between two atoms, in accordance with the older structural formulæ of chemistry. It is characteristic that there is one atom which may be regarded as the central atom, and for such cases the Heitler-London theory indicates strong localization of bonds.

*Chemical Evidence*[3].—It has been shown that the conception of the lone pair of electrons as an agent for true chemical linkage is in direct contradiction to the results of band spectroscopy. In our opinion, the spectroscopical evidence is of the greatest importance for the following reasons. The difference between two non-electrostatic links (normal and co-ordinate covalency) involves a difference of the role played by individual electrons. Physico-chemical measurements such as the parachor, dipole moment, etc., are concerned with the whole electronic cloud of valency electrons, and *a priori* cannot give information as to the part played by a particular electron. This can only be obtained from spectroscopical experiments. It is therefore always possible to interpret the mechanism of chemical linkage from the results of physico-chemical experiments in alternative ways, as has already been indicated in cases of the parachor, optical activity (for example, toluene-sulphonic esters and beryllium benzoyl-pyruvate), and crystal structure ($SiF_6^{--}$).

Similarly, the increase in dipole moment accompanying the formation of certain molecular associations in solution observed by Earp and Glasstone[4] is no proof of the presence of a co-ordinate link. The dipole moments of such associations sometimes decrease and sometimes increase, depending on the geometrical position of the constituent molecules as to whether there is a cancelling out, or an increase through induction[5]. The energies of dissociation of such complexes, determined by these and other authors, vary between 1 and 10 k.cal./mol., which is about 1/100 to 1/10 of that associated with a true chemical bond. This, in our opinion, proves conclusively that the complexes are loose associations held together by van der Waals forces.

With regard to the resonance linkage suggested, for example, for the $NO_2$ group, it is possible that a co-ordinate link would oscillate between the oxygen atoms if it existed, but no experimental proof has so far been advanced for its existence. These arguments therefore in no way invalidate our earlier conclusion that chemical and physico-chemical evidence fail to provide any proof for the existence of a second form of non-electrostatic linkage in molecules of the first order.

It is true that an atom possessing a lone pair of electrons is frequently associated with chemical reactivity in carbon chains and the formation of complex associations in inorganic chemistry. Since band spectroscopy excludes a mechanism of the 'donor' and 'acceptor' type, something else must be responsible for such phenomena. As a tentative suggestion, it may be pointed out that the molecular refractivity indicates that the polarizability is always high in such atoms so long as the electrons of the lone pair are not involved in chemical linkage, and that the large dipole moment induced on approach of a reagent molecule might be responsible for such phenomena.

We wish to express our gratitude to Prof. F. London for his help in connexion with the wave mechanical section of this article.

[1] See Hunter and Samuel, *J. Chem. Soc.*, 1180 (1934); Lessheim and Samuel, *Proc. Ind. Acad. Sci. (Bangalore)*, 1, 623 (1935), and the literature mentioned in these papers.

[2] Lessheim and Samuel, *Phil. Mag.*, 21, 41 (1936); Asundi and Samuel, *Proc. Phys. Soc.*, 48, 27 (1936); *Proc. Ind. Acad. Sci. (Bangalore)*, 2, 30 (1935); 3, 466 (1936); Asundi, Jan Khan, and Samuel, *Proc. Roy. Soc.*, in press, and literature mentioned there.

[3] Hunter and Samuel, *Chem. and Ind.*, 54, 31, 467, 635 (1935); *Rec. trav. chim.*, 54, 114 (1935), and literature mentioned there.

[4] *J. Chem. Soc.*, 1709 (1935).

[5] cf. Stuart, "Molekülstruktur," p. 114 (1934).

# Science News a Century Ago

## Death of John Pond, F.R.S.

ON September 7, 1836, John Pond, the sixth Astronomer Royal, died at Blackheath at the age of sixty-nine years, and a few days later was buried in the tomb of Halley in Lee churchyard. Pond was born in London in 1767. After attending schools at Hadleigh and Maidstone, at the age of sixteen years he entered Trinity College, Cambridge, and attended the mathematical lectures of Vince. Ill-health led him to travel, and during visits to Portugal, Malta, Turkey and Egypt he made many astronomical observations. From 1798 until 1807 he lived at Westbury, near Bristol, where by his observations on the declination of some of the principal stars he showed conclusively that Bird's quadrant at Greenwich had altered its form.

Pond was elected a fellow of the Royal Society in 1807. He married and removing to London in 1811 was chosen to succeed Maskelyne at the Royal Observatory. In 1812 he mounted a six-foot mural circle by Troughton, in 1816 a transit instrument of 5-in. aperture, in 1821 substituted the mercury horizon for the plumb-line and spirit-level, and in 1825 introduced the system of observing the same object by direct and reflected vision. A sound practical astronomer, he published catalogues of stars, translated Laplace's "Système du Monde" and wrote many articles for Rees' "Encyclopædia". In 1817 he was awarded the Lalande Medal and in 1823 the Copley Medal. He was succeeded at Greenwich by Airy, who, writing to Henry Warburton, M.P., to support an application for a pension for Mrs. Pond, said that Pond's claims to the gratitude of astronomers were due first to the accuracy which he introduced into all the principal observations, secondly, to the attention he bestowed on those points (chiefly of sidereal astronomy) which he regarded as fundamental, and thirdly his regularity of observation. "Since the commencement of Mr. Pond's residence at Greenwich," said Airy, "Astronomy considered as an accurate representation of the heavens in the most material points has acquired a certainty and an extent which it never had before."

## Discovery of Fossils on the Continent

IN its column of Miscellanea, the *Athenæum* for September 10, 1836, said: "Dr. Klippstein, a German savant, who has been long devoted to geology, and who directs the researches in the environs of Alzei (a little town of the Rhine Hesse) has lately made a discovery. On digging twenty-eight feet under the soil, near Eppelsheim, and a league from Alzei, his workmen found a head of a Dinotherium giganteum, in perfect preservation. This is probably the most colossal of all antediluvean animals, and the existence of which was first pointed out by the learned zoologist, Dr. Caup. This head is six feet long and three feet and a half broad. Near the head was also found a shoulder bone of which remains have not been met with elsewhere. Also at one thousand feet below the surface, in the mines of Anzin, an entire fossil palm tree has been found in an upright position. Its roots pierced the soil to a depth of several feet, and it is to be brought to the Museum of Natural History in the Jardin des Plants."

The neighbourhood of Mainz and Alzey early attracted the attention of geologists on account of its wealth of fossils. Von Zittel said: "The discovery

of the famous Dinotherium skull at Eppelsheim by Klipstein and Loup induced Klipstein to contribute a more careful stratigraphical account of the strata in the Mainz basin, and he paralleled the bone-bearing sands of Epplesheim with the gypsum of Montmartre, and the limestone strata under the bone-bearing sands with the coarse limestone beds of Paris."

### Yarrell's History of British Fishes

AMONG the books on natural history published in 1836 was the "History of Fishes" by William Yarrell (1784–1856), an original member of the Zoological Society and at one time treasurer to the Linnæan Society. In a review of his work in the *Athenæum* of September 10, 1836, it was said the book was "intended to form a continuation of Bewick, whose beautiful woodcuts, occasional vignettes and *naive* descriptions will ever be ranked among our standard works . . . and we can safely say, to all those who possess Bewick's works, that their collection is not complete without adding Mr. Yarrell's fishes to the birds and beasts.

"The description of species are 226 in number, but as several of them are figured in various stages of growth, the representations amount to 240—all made under the superintendence of the author; besides which there are more than 140 vignettes of modes of fishing, boats, nets, etc., foreign and English."

## Societies and Academies

### Paris

Academy of Sciences, July 15 (*C.R.*, 203, 137–216).

GABRIEL BERTRAND and LOUIS DE SAINT-RAT: A new colour reaction of copper with urobilin. This reaction is more sensitive and more specific than other reactions in use for the detection of traces of copper. 0·0001 mgm. of copper in 1 ml. of solution can be detected with certainty.

GABRIEL BERTRAND: Pentacetylxylite. Details of the preparation and purification of the acetate.

ROBERT LESPIEAU: The synthesis of *r*-arabite.

SERGE BERNSTEIN: Some extremal properties of successive integrals (correction).

CHARLES PISOT: Certain characteristic properties of algebraic numbers.

FARID BOULAD BEY: The canonical forms of equations of nomographic order 6 and 5 representable by nomograms with symmetrical scales.

CHRISTIAN PAUC: Directions, contingent and paratingent in *distanciés* spaces.

V. A. KOSTITZIN: The differential equations of the problem of Mendelian selection.

GINO ARRIGHI: The expression of the energy of acceleration.

JEAN JACQUES TRILLAT and MLLE. RENÉE VAILLÉ: The unctuosity of mineral lubricating oils.

MME. H. EMMANUEL-ZAVIZZIANO and M. HAÏSSINSKY: The electrolysis of solutions of titanium salts. By varying the conditions of the electrolysis, compounds of Ti'', Ti''', Ti'''' and of pertitanic acid can be prepared.

MICHEL KANTZER: The optical absorption of the vapours of tellurium dichloride and oxychloride.

PIERRE LAMBERT and JEAN LECOMTE: Description of a recording spectrometer with a grating and its use for the determination of the absorption spectra of benzene derivatives in the 3000 cm.$^{-1}$ region.

AUGUSTIN BOUTARIC and JEAN BOUCHARD: Study of the fluorescent power of some fluorescent solutions excited by ultra-violet rays.

MLLE. YVETTE CAUCHOIS: Study of the *L* spectra of emission and absorption of rhenium (75) I.

MARCEL LECOIN: The form of the continuous β-spectrum of radium E. The method was based on the use of a Wilson chamber placed in a magnetic field. The results are given as a curve, and differ considerably from the values found by the method of coincidences.

CHARLES HAENNY: The secondary radiation emitted under the action of neutrons.

MAURICE E. NAHMIAS and ROBERT J. WALEN: Some short periods in artificial radioactivity.

HENRI MURAOUR and GABRIEL AUNIS: The laws of combustion of colloidal [explosive] powders.

MLLE. NIUTA KLEIN: The transformation in glass.

MLLE. VALERIE DEUTSCH: The absorption of proteins. Crystallized hæmoglobin from the horse.

EDOUARD RENCKER and PIERRE DUBOIS: The hydrates of manganous sulphate. The only definite hydrates are those containing 7, 5, 4, 3 and 1 molecules of water.

ALFRED MAILLARD: The system monomethylamine-calcium chloride.

MAXENCE MEYER: A new method of preparation of the diethoxysuccinic esters.

LÉON ENDERLIN: Contribution to the study of the reversible oxidizability of organic compounds. Iso-oxybis-*p*-bromphenyldiphenylnaphthacene.

LÉON DENIVELLE: The sulphate of *o*-phenylene or sulphurylpyrocatechol.

CHARLES COURTOT and MOHAMMED GHOLI BASTANI: Introduction to the study of the chemistry of diphenylene telluride.

MLLE. BERTHE DELAPORTE: Cytological researches on the group Coccaceæ.

WILLIAM HENRI SCHOPFER: Researches on the nitrogen metabolism of a micro-organism.

CHARLES CHABROLIN: The germination of the seeds of the orobanche bean (*Orobanche speciosa*). The substance which induces the germination of the seeds of the orobanche bean diffuses round the roots of certain plants and can be washed out with water.

PAUL BERTRAND: The embryos of angiosperms, ferns and lycopods.

FRANCIS RATHERY, ANDRÉ CHOAY and PIERRE DE TRAVERSE: The comparative action of insulin and of the hypoglycæmic principle of the jejunum in the depancreated dog.

RAYMOND-HAMET: A new method of showing sympathicolytic power.

GUSTAVE GUITTONNEAU and RENÉ CHEVALIER: The utilization of salicylic acid as an energy producing food by *Azobacter* in the soil.

ANTHELME ROCHAIX and PIERRE RIVOLLIER: A dissociation of the staphylococcus.

### Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 327–434, June 15).*

DAVID I. MACHT and RAYMOND E. GARDNER: Phytopharmacological reactions of normal, toxic and atoxic sera. The phytotoxic index is defined as the ratio of the rate of growth in the dark for 24 hours at 12° C. of roots of seedlings of *Lupinus albus* immersed in a solution to be examined to the rate

* *Continued from p. 378.*

of growth of controls in a nutrient solution under the same conditions. Normal human blood and blood sera from a number of animals gave an index averaging 75 per cent. Reptilian blood was very toxic, as was also that of sera from cases of pernicious anæmia, pemphigus and leprosy. Virus diseases gave sera less toxic for plant growth than normal blood sera.

ALBERT W. HULL: Changing direct current to alternating current by means of thyratrons. Constant voltage 3-phase A.C. was changed to constant current by a 'monocyclic network' of capacitors and reactors. This current was converted by a conventional circuit of radio type into a constant direct current. The direct current is changed back into alternating current by an exactly similar circuit, with thyratrons in place of rectifiers. Special tubes were developed for the purpose, and in a circuit described, 15,000 volts at 200 amp. peak is rectified to 200 amp. at 30,000 volts D.C., and the latter 'inverted' to alternating current.

FRANCIS G. BENEDICT and JOHN M. BRUHN: Chimpanzee metabolism. Twenty-two animals ranging in age from two months to fifteen years were used. Respiratory exchange was measured with an open-circuit respiration chamber, the out-coming air being sampled. The average heat production of a chimpanzee per $10 \times w^{2/3}$ (where $w$ is weight), ranges around 1,000 calories. Unlike man, it is not unusually high in infant and pre-adolescent years.

C. P. HASKINS and E. V. ENZMANN: A determination of the magnitude of cell "sensitive volume" associated with the white-eye mutation in X-rayed *Drosophila* (2)

C. P. WINSOR and ANNA-BETTY CLARK: Dark adaptation after varying degrees of light adaptation. The shape of human dark adaptation curves changes with the degree of initial light adaptation. The results are consistent with Wald's view that three substances are involved in the visual purple cycle.

FRANCIS G. BENEDICT and ROBERT C. LEE: Studies on the body temperatures of elephants. The temperature of urine taken immediately it was voided averaged 35·9° C.; that of the fæces was 0·7° C. higher, due to fermentation. The elephant thus has the lowest body temperature of any of the large animals (man 37° C., birds 42° C.).

MORGAN UPTON: Differential sensitivity in sound localization. When the two ears are stimulated by equal energies at 800 cycles, the apparent sound is localized in the median plane of the head. The ratio of energy increment required to produce a noticeable shift of localization to original energy is large for low levels of energy, small for intermediate levels and increases again for very high levels. The results cannot be described in terms of the Weber-Fechner law.

W. J. CROZIER: On the sensory discrimination of intensities. The increment of light intensity which is just detectable is variable and should be treated statistically. The relation of sensory intensity (effect) to stimulating intensity should be discussed as a 'band' which measures the probability of occurrence of the index response.

MORGAN UPTON and W. J. CROZIER: On auditory intensity discrimination. A theoretical discussion of Upton's results (above). The energy increment involved can only be regarded as related to the mechanism of excitation so long as its statistical character is recognized.

J. VAN OVERBEEK: Light growth response and auxin curvatures of *Avena*.

JAMES BONNER: Plant tissue cultures from a hormone point of view. Parenchyma tissue from the lining of the 'cups' left when immature seeds are removed from bean pods has shown cell elongation and cell division *in vitro* in a culture medium to which an alcohol extract of fresh beans was added. The cell mass continued to grow as parenchyma, and a limited number of sub-cultures could be made, but from the central tissue only. Some chemical properties are given of the factor which seems to make growth possible.

CARL IVER HOVLAND: 'Inhibition of reinforcement' and phenomena of experimental extinction.

KENNETH W. COOPER: Demonstration of a hatching secretion in *Rana pipiens* Schreber. The jellies and vitelline membranes of early tail-bud larvæ were removed, and the freed embryos were kept in water until normal embryos of similar age had hatched. The contents of dishes containing free embryos were filtered and the filtrate centrifuged and decanted. This liquid was able to remove the jellies from fertilized eggs, etc., the vitelline membrane swelling away from the egg or rupturing, at stages when manipulative removal is very difficult.

## Vienna

Academy of Sciences, June 12.

JOVAN JURIŠIĆ: Morphology and biology of *Bryophyllum Daigremontianum* (Hamet and Perrier de la Bâthie).

HEINZ HORNINGER: Geometrical theory of reflection at curved surfaces.

WALTHER RUZICZKA: Accumulation of iodine by cumarin derivatives.

LEOPOLD SCHMID and HUGO KÖRPERTH: (1) The colouring matter of the poppy. (2) Extracts of petals.

F. WESSELY, A. MÜNSTER, and K. SCHÖNOL: The bitter principle of Columbo wood. (4). Hydration of columbin and isocolumbin.

RICHARD SCHUMANN: The moon, sun and variation of latitude (2).

OTTO REDLICH, TRUDE KURZ and WALTER STRICKS: Raman spectra and constitution of hexabromostannic ion and hypophosphite ion. The occurrence of five fundamental frequencies in its Raman spectrum shows that the hexabromostannic ion has $D_{4h}$ symmetry.

O. FRIEDRICH: Geology of the gravel bed of the Gross-Arl valley.

ELFRIEDE EYSANK: Coloration of fluorite and rock salt. Fluorite has an absorption band between 575 and 650 mμ and another between 380 and 405 mμ. The properties of these two bands are studied.

IRMBERTA LEITNER: Quantum yield in the coloration of rock salt by X-, γ-, and β-rays. X-rays produce $10^4$–$10^5$ and β- or γ-rays $10^8$–$10^9$ colour centres per quantum. High energy quanta probably act through the secondary radiation they produce.

E. GUTH and S. ROGOWIN: Mechanical properties of threads and films of cellulose derivatives.

KARL SCHWARZ and FRANZ EBSTER: The possibility of producing multiply ionized atoms of very high energy.

O. BRUNNER and W. KLEINAU: Visual purple (2). Mechanism of the bleaching process.

FRIEDRICH HARTMANN: The most general case of breaking of rods of structural steel.

## Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (BLACKPOOL MEETING).

### Wednesday, September 9

At 8.30 p.m.—Sir Josiah Stamp, G.C.B., G.B.E.: "The Impact of Science upon Society" (Presidential Address in the Empress Ballroom, Winter Gardens).

### Thursday, September 10

At 10 a.m.—Prof. J. C. Philip, F.R.S.: "The Training of the Chemist for the Service of the Community" (Presidential Address to Section B, followed by a discussion).

Dr. J. S. Huxley: "Natural Selection and Evolutionary Progress" (Presidential Address to Section D).

Brigadier H. S. L. Winterbotham: "The Mapping of the Colonial Empire" (Presidential Address to Section E).

Prof. W. Cramp: "The Engineer and the Nation" (Presidential Address to Section G).

Miss D. A. E. Garrod: "The Upper Palæolithic in the Light of Recent Discovery" (Presidential Address to Section H).

Mr. J. Ramsbottom: "The Uses of Fungi" (Presidential Address to Section K).

Sir Richard Gregory, Bt., F.R.S., Prof. L. Hogben, F.R.S., S. R. Humby, S. V. Brown, Sir Daniel Hall, F.R.S.: "Cultural and Social Values of Science" (Discussion: Section L).

Sir John Orr, F.R.S., Sir Daniel Hall, F.R.S., Prof. J. A. S. Watson, Prof. H. D. Kay: "National Nutrition and British Agriculture" (Discussion: Section M).

At 2 p.m.—Conference of Delegates of Corresponding Societies. Dr. A. B. Rendle, F.R.S.: "Preservation of Native Floras" (Presidential Address).

At 4.30 p.m.—Exhibition of new Biological Films.

At 7.30 p.m.—Dr. Olaf Bloch: "The Scope of Photography" (Public Lecture at Lytham St. Annes).

### Friday, September 11

At 10 a.m.—Prof. A. Ferguson: "Trends in Modern Physics" (Presidential Address to Section A).

Dr. C. R. Fay: "Plantation Economy" (Presidential Address to Section F).

Prof. R. J. S. McDowall: "The Control of the Circulation of the Blood" (Presidential Address to Section I).

A. W. Wolters: "Patterns of Experience" (Presidential Address to Section J).

Sir Richard Livingstone: "The Future of Education" (Presidential Address to Section L).

Denys W. Harding, F. C. Thomas, Rev. F. A. Farley: "The Psychology of Mass Entertainment" (Discussion: Section J).

At 2.15 p.m.—Prof. H. J. Fleure, F.R.S., Dr. J. S. Huxley, Dr. G. M. Morant, Prof. A. M. Carr-Saunders, Prof. R. Ruggles Gates, F.R.S., Prof. F. A. E. Crew: "Genetics and Race" (Discussion: Sections D and H).

At 7.30 p.m.—Dr. W. F. Bewley: "Science and the Glass-house Industry" (Public Lecture at Blackpool South).

At 8 p.m.—Prof. J. L. Myres: "Who were the Greeks?" (Public Lecture at Preston).

Sir James Jeans, F.R.S.: "Some Recent Advances in Astronomy" (Public Lecture at Southport).

At 8.15 p.m.—C. C. Paterson: "Science and Electric Lighting" (Evening Discourse).

## Official Publications Received

### Great Britain and Ireland

*Air Ministry: Aeronautical Research Committee: Reports and Memoranda.* No. 1685 (2038a): Effect of Variation of Aileron Inertia and Damping on Flexural-Aileron Flutter of a Typical Cantilever Wing. By V. M. Falkern. Pp. 12+6 plates. 1*s.* net. No. 1693 (2237): *Air and Vapour Locks in Fuel Systems.* By M. A. A. Allfrey. Pp. 14+9 plates. 1*s.* 3*d.* net. (London: H.M. Stationery Office.) [108

Imperial Economic Committee. An Index of the Minor Forest Products of the British Empire. Pp. 116. (London: H.M. Stationery Office.) 5*s.* net. [118

Proceedings of the Royal Society of Edinburgh, Session 1935–1936. Vol. 56, Part 2, No. 7: Fossil Pollen in Scottish Tertiary Coals. By Dr. J. B. Simpson. Pp. 90–108+3 plates. 2*s.* 6*d.* Vol. 56, Part 2, No. 8: On the Suppression of Tangled in *Drosophila pseudo-obscura*. By H. P. Donald. Pp. 109–127+2 plates. 2*s.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [128

The North of Scotland College of Agriculture. Calendar, Session 1936–1937. Pp. viii+131. (Aberdeen: North of Scotland College of Agriculture.) [128

### Other Countries

*Conseil Permanent International pour l'Exploration de la Mer.* Rapports et procès-verbaux des réunions. Vol. 100. 1ère partie: Procès-verbaux (mai 1936). Pp. 62. 3.00 kr. 2ème partie: Rapport administratif (1935–1936); 3ème partie: Appendices. Pp. 111+25. 4.00 kr. (Copenhague: Andr. Fred. Høst et fils.) [118

Cornell University: Agricultural Experiment Station. Bulletin 640: An Economic Study of Land Utilisation in Chemung County, New York. By T. E. LaMont. Pp. 84. Bulletin 641: Seasonal Costs and Returns in producing Milk in Orange County, New York. By L. C. Cunningham. Pp. 41. Memoir 183: Measurements of Family Relationships in Farm Families of Central New York. By Howard W. Beers. Pp. 38. Memoir 184: Pollination and Life-History Studies of the Tomato (*Lycopersicon esculentum* Mill). By Ora Smith. Pp. 16+23 plates. Memoir 185: Effect of Narrow Ranges of Wave-Lengths of Radiant Energy and other Factors on the Reproductive Growth of Long-Day and Short-Day Plants. By N. A. Schappelle. Pp. 33. Memoir 186: Effects of some Environmental Factors on Growth and Color of Carrots. By W. C. Barnes. Pp. 36. (Ithaca, N.Y.: Cornell University.) [178

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# Science and the Community

CENTURIES of tradition and experience have given us, as Prof. A. N. Whitehead has pointed out, a tradition that each generation will live substantially amid the conditions governing the lives of its fathers and transmit those conditions to the succeeding generation. In his words, "we are living in the first period of human history for which this assumption is false". The time span of important change no longer exceeds considerably the normal span of human life, and we have now to meet change as the normal—not the exceptional—experience.

This necessity for change has at least two aspects. It involves the modification of man's nature to meet the new conditions, a re-adaptation to his environment. It also involves the modification of his existing social, economic, political and industrial organization and institutions to meet the requirements of an era of power production and rapid change, or the evolution of new forms of organization where the old prove inadequate and incapable of development.

The seriousness of the present international situation, no less than our economic difficulties, is largely due to the failure to face change and adapt institutions to meet it. In the Fascist and totalitarian State there are deliberate attempts to put back the clock and return to a simpler order of society, creative thought and adaptability being repressed in an attempt to maintain institutions evolved in a pre-industrial era. Simultaneously, in the assumed defence of the State, the full resources of a power production era are being marshalled for destructive purposes.

On the scientific side, even though in the training of the man of science there is still no concern with the social consequences of his work, scientific workers are to an ever-increasing extent turning their attention to such matters. In the five years since, in his presidential address to the British Association, General Smuts directed attention to the dangers arising out of rapid scientific advance as opposed to a stationary ethical condition, the relations between science and society have been considered on an increasing scale at the British Association meetings both in the presidential addresses and in sectional meetings. Two years ago, the Council suggested in a memorandum to the organizing committees of the various sections that discussions, papers or symposia should be included in their programmes bearing upon the relations between the advance of science and the life of the community.

The attention given to this subject in the programme of the present meeting is fully as great as in previous years. Discussions on chemistry and the community, cultural and social values of science, national nutrition and British agriculture, the psychology of mass entertainment, the reform of the examination system, the poultry industry, traffic safety, chemistry and food science, the strain of modern civilization, and addresses on the engineer and the nation, soil science in the twentieth century, etc., indicate over how wide a field scientific workers are seeking the solution of problems of social well-being and the interpretation of the results to the general community.

It is not on this account alone, however, that the impact of science upon society forms most appropriately the main theme of this year's presidential address. While more scientific effort than ever before is probably being devoted to the elucidation of social problems and the interpretation of the results to the community, there has

never been more general alarm about the possibilities of the application of the results of scientific discovery or greater willingness to endorse the late Sir Alfred Ewing's words: "The command of Nature has been put into man's hand before he knows how to command himself."

For this uneasiness the rapid deterioration in international relations during the past year, the weakening of international co-operation and the grim menace of re-armament have been largely responsible. In the growing effort being devoted to preparation for warfare, it is easy for the possibilities of a higher standard of living which science has placed within our grasp to be overlooked, and for the scientific worker to be associated rather with the perversion of his knowledge for destructive purposes. Again, the intensification of preparation for self-defence has tended to strengthen the fetters on freedom of investigation and exposition which dictatorships in many countries have already riveted on industrial and academic workers alike.

The growing impatience of the scientific worker at the extent to which his knowledge is made to serve inhuman ends finds admirable expression in Prof. J. C. Philip's presidential address to Section B (Chemistry) and is paralleled by the alarm at the continued threat to academic freedom and scientific research itself which, as the University Grants Committee pointed out in its report, lays a heavy responsibility on the universities of Great Britain if the Greek tradition of candid and intrepid thinking about the fundamental issues of life is to be preserved for mankind.

Sir Josiah Stamp, in his presidential address to the Association, which appears elsewhere in this issue (p. 435), has thrown down a challenge to creative thought on the impact of science upon society and the technique of change it involves, which comes at an opportune moment. The development of economic planning on a larger scale has made it painfully evident how the full effects of the wisest schemes may be neutralized by factors outside their control. Only by the widest co-ordination can the fullest benefits be secured, whether within the limits of an industry or of a national unit. The resistance of institutions to change not only increases the friction and makes change more difficult and the application of science less profitable and less readily accepted; it also tends to throw out of ratio what Sir Josiah Stamp has termed the scientific, industrial and political periods of gestation.

The present tendency is for the period of scientific gestation, or the interval between the first concept of the idea and its publication in substantially the form in which it is ultimately used extensively, to contract. It is even more demonstrable that industrial gestation, or the subsequent interval between this point and the time when the innovation becomes effective in an economic or industrial sense, has shortened materially and at greater social cost. This contraction is attributed to the greater amenability of the industrial community to scientific research and to our entering on an epoch of concerted industrial research in the last twenty years.

It is to the third question, that of political gestation, that Sir Josiah Stamp directs particular attention. Formerly, the normal span of life of man and machinery provided a phase to which scientific advance could be adjusted for a completely smooth social advance. Technical changes now occur so rapidly that political institutions work far too slowly to make the required adaptation. Political gestation is a function both of human psychology and of social structure, and at present we do not know enough about the way in which ideas permeate, infiltrate or saturate society.

While to prevent disequilibrium it is necessary to evolve some means of contracting the period of political gestation, some of the factors which hitherto have diminished the force of impact on society are losing their previous force. Among such, Sir Josiah Stamp cites the natural increase of population, which is disappearing in all Western industrial countries, and the labour demands of new industries, which offset dislocations caused by labour-saving machinery.

If, therefore, the risk of innovation becomes mechanically rapid, the danger of improvident tardiness is the more acute, and it becomes essential to treat on scientific lines those questions of man's abilities, his affections and his tools which have been brusquely dismissed in the past. With the intensification of scientific effort and the greater subdivision of industry, the possible dislocation becomes more frequent and the way of meeting such change of greater public importance. Impact and change must, in fact, be treated as an area for scientific study, and society must endeavour to regulate the rate of change to an optimum point in the net balance between gain and damage.

No scientific worker can fail to recognize the practical difficulties of economic and political

prevision, as involved, for example, in Sir James Irvine's plea for a Ministry of Knowledge for the purpose of predicting the repercussions of new knowledge on all phases of life. None the less, a deliberate attempt may yet have to be made. Moreover, it is clear that the moral and social consequences of innovation, no less than the material, must be taken into account in our calculations, and it may even be desirable to repress the rate of development on the physical side in order to accelerate assimilation on the moral and human aspect. Birth control, for people, may yet demand corresponding measures for their impedimenta.

Sir Josiah Stamp adds one more voice to those which in recent years have pleaded for redistribution of scientific effort and resources. There is not too much effort being devoted to research in physics and chemistry as modifying industry, but there is too much relatively to the research upon the things they affect in physiology, psychology, economics, sociology. Additional financial resources should be applied more to the biological and human sciences than to the applied physical sciences or, if resources are limited, transfers should be made from one to the other.

What is required is not less science but a great extension of the area to which the scientific method is persistently and dispassionately applied. This is no time for a spirit of defeatism but for fuller support of those means of acquiring knowledge on the human and biological side where it is at present deficient. We must achieve an advance in the science of man commensurate with that which we have already secured in the science of matter.

For this task there are two essentials—a time of peace in which the problems can be effectively studied and the adjustments made, and courage and confidence strengthened by the conviction that the human spirit is not doomed to relapse into barbarism, but is fully as capable of emerging from an age of mechanization and standardization to one in which the teeming units of mankind enjoy not merely physical comfort and adequate leisure but also freedom of access to all the rich heritage of civilization. If scientific workers are stimulated by the presidential address and other discussions at the Association's meetings to make more constructive contributions to this question of peace and the impact of science upon society, the Blackpool meetings may well be memorable in annals wider than those of science alone.

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# Geophysics of the Indo-Pacific Region

**Geographie des Indischen und Stillen Ozeans**
Im Auftrage der Deutschen Seewarte verfasst von Prof. Dr. Gerhard Schott. Mit einem Beitrag von Prof. Dr. Ernst Hentschel und Dr. Wolfgang Schott. Pp. xx + 413 + 38 plates. (Hamburg: C. Boysen, 1935.) 36 gold marks.

EVER since Prof. G. Schott, ten years ago, published his great work on the geography of the Atlantic Ocean, geographers and oceanographers have been eagerly awaiting the companion volume on the Indo-Pacific region. In the present work the author has followed the same original plan and, commencing with a historical account of the discovery and exploration of these two oceans, he brings under review the whole sum of our present knowledge, ranging from the geological character of the coasts, through the topography and nature of the sea-floor, the meteorological conditions, the current systems and the physico-chemical character of the sea-water from the surface down to the great depths in the various regions into which these two oceans are divided, to the biological conditions present, including in this latter topic a survey of the anthropology of the whole area.

In his historical account of the great explorers, who opened up for us these wide spaces, Schott mentions the name of Francis Drake in a footnote and in his chart only shows him as having visited the west coast of America, whereas he also sailed the Malay seas, visiting Java and the Moluccas, and was in all probability the first to discover the Giant Robber crab (*Birgus latro*) and to note its habit of living in colonies and of climbing trees.

One great difficulty, which confronts all oceanographers, is the uncertainty of the mode of origin of the great oceans, and this applies especially to the northern part of the Indian Ocean, regarding which one school of geologists holds that it has been formed by the foundering of a great continent, Gondwanaland, while another school believes with Wegener that the oceans have been formed by a gradual drifting apart of the present continental masses. Schott apparently belongs to the former school, and he describes how Africa, Arabia and India are all stable land-masses that

are bounded by scarp-faults, where the hypothetical continent of Gondwanaland, that once connected them, has broken off and subsided; it is to this permanence of these land-masses that Schott attributes the apparent comparative freedom of the Indian Ocean from volcanic islands, though, since we are as yet completely ignorant of the geological nature of the basis on which the Laccadive, Maldive and Chagos archipelagos rest, this freedom may be more apparent than real. Down the whole length of the Indian Ocean and across the south-eastern part of the Pacific Ocean two great submarine ridges have now been traced, the two together forming an almost complete semicircle that runs around nearly half the circumference of the globe; but wherever these ridges rise above sea-level, or fragments of rock have been obtained from the sea-floor along their length, the rock has been found to be volcanic in origin and is composed of basalt, thus giving no indication of its geological age; and Schott is thus scarcely justified in claiming that the recent John Murray Expedition, which in 1933–34 mapped a great part of the Carlsberg Ridge and discovered a subsidiary ridge running up towards and probably representing a submarine continuation of the Khirtar Range of India, has thus provided further evidence of the former existence in Permo-carboniferous times of Gondwanaland, or even of its later relic, the isthmus of Lemuria.

In discussing the great 'deeps' that almost invariably lie close to the eastern side of a continental land-mass, Schott reviews the possibility that these have been produced by either faulting or folding, but he makes no mention of the alternative theories of isostatic adjustment or of continental drift.

In his account of the currents, both surface and deep, Schott brings out clearly the enormous importance of the correlated study of the general meteorological conditions; evaporation and solar radiation produce differences in density of the water, thus inducing sinking of water-masses downwards, while the prevailing winds, by inducing horizontal movement of the surface-water in different directions, cause the zonation of the great oceans into tropical, sub-tropical and polar regions, separated from one another by 'convergence zones', along which one mass of water is driven beneath another and sinks down to a deeper level, thus causing a stratification of the ocean into depth-zones, in which temperature, salinity, oxygen content, etc., are sufficiently different to enable us to trace the course of the deep currents and thus discover the manner in which the deeper waters of the Atlantic and Indian Oceans sweep eastward to the south of the continental masses of Africa and Australia and flow into the Indian and Pacific Oceans respectively. Similarly, the Trade winds, by setting up off-shore currents, cause an up-welling of deep cold water that has a profound influence on the character of the fauna and flora, one notable effect of such up-welling being the absence of coral reefs even in tropical regions, as, for example, on the western coasts of Africa and South America or the south-eastern coast of Arabia and the neighbouring coast of Africa. Yet off the north-western coast of Australia, where the conditions would appear to be favourable to its formation, such up-welling appears to be absent.

The zonation of the surface water has, at any rate in certain regions, a profound influence on the character of the sea-bottom, for, as Schott points out, there is a close agreement between the south polar convergence zone and the change on the sea-floor from the tropical and sub-tropical Globigerina ooze to the polar Diatom ooze, and, to a less degree, the same holds good for the north polar convergence zone. It is, however, difficult to understand how this agreement is brought about, for it is now well known that the polar water, characterized by a profusion of diatom growth, dips at the convergence zone downwards under the sub-polar water and flows northwards towards the equator, and one would have expected this Antarctic Intermediate Current to carry the slowly sinking frustules of the diatoms far to the north; but for some reason not yet understood the convergence zone appears to mark, not only a change in the surface conditions, but one also in the general character of the plankton at all depths.

Another problem connected with the sea-floor is the mode of formation of the Red Clay that covers vast areas of the north and south Pacific regions and the eastern part of the Indian Ocean. The conditions favouring its formation appear to differ radically in these areas and in the Atlantic, for in this latter ocean the Red Clay is deposited where the Antarctic Bottom Current is strongest, whereas in the Pacific the reverse seems to be the case, and in the Indian Ocean to the north-east of the Carlsberg Ridge there is a patch of this deposit in an enclosed basin, where the bottom current must be at a minimum; nor in this connexion do we know anything regarding the mode of formation of the manganese nodules that are so characteristic of Red Clay deposits, and even less regarding the original source of the manganese.

Dr. Schott is to be congratulated on the completion of this most valuable work, in which he has rendered available so much information; but if there is one thing that is brought out most clearly, it is the great need of further investigation in every part of these oceans, which are "by nature left free for all men to deal withal, as very sufficient for all men's use, and large enough for all men's industry". R. B. SEYMOUR SEWELL.

# All Manner of Televiewers

(1) Television Reception:
Construction and Operation of a Cathode Ray Tube Receiver for the Reception of Ultra-Short Wave Television Broadcasting. By Manfred von Ardenne. Translated by O. S. Puckle. Pp. xv + 121 + 43 plates. (London: Chapman and Hall, Ltd., 1936.) 10*s*. 6*d*. net.

(2) Popular Television:
Up-to-date Principles and Practice explained in Simple Language. By H. J. Barton Chapple. Pp. xiii + 112. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 2*s*. 6*d*. net.

(3) Television
By M. G. Scroggie. (Blackie's "Technique" Series.) Pp. ix + 68 + 7 plates. (London and Glasgow: Blackie and Son, Ltd., 1935.) 3*s*. 6*d*. net.

HE is a wise author who knows his own reader; he is a daring author who writes for more than one reader. The first public demonstrations of high-definition television will have rekindled the enthusiasm of the three main classes of potential televiewer, and these enthusiasts will turn to such books as those now before us for some guidance on how television works. On the criteria suggested, Baron von Ardenne is the wisest, Mr. Barton Chapple the most heroic, of our three authors. Mr. Barton Chapple writes for "the public", Mr. Scroggie, in an attractive preface, explains that he has tried to provide "a fairly comprehensive and unpadded survey for [the wireless amateur] without being unintelligibly concentrated for [the non-technical public]; so that neither is the one exasperated nor the other bewildered". Baron von Ardenne, with his more-than-translator and almost co-author Mr. Puckle, address themselves to the advanced amateur and the engineer. Mr. Scroggie's *via media* proves itself *tutissima* and his book can be recommended to the "wireless amateur who is already familiar with ordinary broadcasting"—and the class is an amazingly large one—as a clear well-balanced account of the present state and immediate possibilities of television, with a sufficient glance at the obsolescent, and a fair-minded scrutiny of the up-to-date. Mr. Barton Chapple does not wholly succeed in his difficult task of speaking to the non-technical public without going beyond its limited vocabulary; there are points at which he probably leaves it bewildered by dropping unconsciously back into the familiar jargon of the wireless amateur and engineer. His book is a good one, but he could make it better in its next edition by forgetting the wireless amateur and writing for one intelligent middle-aged lady who would like to know how she is to see the coronation next year from Croydon.

Baron von Ardenne's important work reveals the magnitude of the self-imposed task which will be undertaken by the many advanced amateurs who decide to build their own receivers for high-definition television. He does not gloss over the economic and technical difficulties and he produces, as he always does, a stimulating book which will certainly, as he hopes, "provide an impulse towards intense activity on the part of amateurs in the newest and perhaps most interesting branch of electrical engineering". He is also fully justified in his "hope that certain paragraphs will bring to the television specialist some fundamentally new ideas".

The book is not easy reading, for it is compressed and occasionally elliptic, but it never goes further in these directions than is compatible with stimulation short of exasperation. The keen amateur will have to stop fairly frequently to think how much has been said and how much the author has assumed it safe to leave unsaid because his selected reader will know already. The "construction and operation of a cathode ray tube receiver for the reception of ultra-short wave television broadcasting" will be made possible, but not disappointingly easy, for the advanced amateur who has the good fortune to read this book—and what fun, what fury and despair, what triumphs it will open up for him! The general treatment is philosophically and scientifically excellent, the book contains technical data not readily available elsewhere, and the detailed "Parts Lists", circuit diagrams, and descriptive material on mains supply units, time bases, filters, picture receivers and sound receivers are clear and satisfactory.

It has already been indicated that the book is more than a translation. Mr. Puckle, who has himself done very notable work in the advance of high-definition television, has introduced into the text a considerable amount of matter designed to help the home-constructor who is to deal with the London as opposed to the Berlin television service. These additions are very valuable, indeed essential, but it would have been better to set clearer boundary marks between the von Ardenne and the Puckle contributions. The joints at present

are neither perfect welds nor good clean lap joints. The translation is adequately done, there are no defects in clarity, but Baron von Ardenne's colloquially flexible German takes on an occasionally forbidding aspect in the rigidities of a safe translation.

No one with a serious technical interest in television can afford to be without von Ardenne–Puckle; no one who can read Scroggie's lucid and relatively easy survey will fail to find pleasure and benefit in climbing to the more austere heights with von Ardenne and Puckle.

# Collected Works of Kepler

**Bibliographia Kepleriana**: ein Führer durch das gedruckte Schrifttum von Johannes Kepler. Im Auftrag der Bayerischen Akademie der Wissenschaften. Unter Mitarbeit von Ludwig Rothenfelder. Herausgegeben von Max Caspar. Pp. 158+86 plates. (München: C. H. Beck'sche Verlagsbuchhandlung, 1936.) 18.50 gold marks.

A POPULAR version of Kepler's letters was published in 1930 by Messrs. Caspar and von Dyck, and was reviewed in NATURE of November 29, 1930, p. 835. Since then Prof. Walther von Dyck has died. We learn that he never lost an opportunity of pressing the claims of Kepler for a collected edition other than that of Frisch—which is open to many objections—and of collecting and studying any documents by Kepler, of which there are a great many. Before he died he had the satisfaction of seeing the Bavarian Academy of Sciences in Munich, with the co-operation of the Deutsche Forschungsgemeinschaft, consent to become responsible for the work. It has named Prof. Max Caspar as editor, and the Würtemberg State Government has set him free from other work for the purpose. He dedicates this volume to Walther von Dyck, and has been able to use the material collected by Dr. Rothenfelder.

The present volume consists of the bibliography preparatory to this edition. The preparatory work seems to have been very thoroughly done. Many of the manuscripts are at Poulkovo. There are certain known collections, public and private. Besides these, circulars were sent out to some 180 libraries, mostly in the neighbourhood of Kepler's residences, to ask them what editions or manuscripts of Kepler they possessed. Most of them replied. It was not to be expected that this step could lead to a large addition to the known works, but some idea of the distribution of these could be got, and also the practical certainty that if any work was missing, it might be looked for elsewhere in vain. However, it *did* lead to certain finds, though not to very important ones.

Actually what we have in this work is, after a preface, eighteen pages of introduction; then four pages of a facsimile of Kepler's communication to Guldin, giving a list of his works edited up to 1621; then sixty-eight pages of works printed in Kepler's time, carefully collated, and each with a descriptive supplement. Several of the minor works have been sought in vain. As Prof. Caspar remarks, "a bibliographer must know what each individual writing contains, from what view it is treated, what is its relation to the whole. So, only a few works receive mention in this book, that I have not been able to see for myself, and for which I had to content myself with taking them out of catalogues, because I could not inspect the originals. All care was taken to give the titles exactly." There are eighty-six titles under this section, originals or duplicates.

After the formal bibliography comes a description of each work. These are pretty full. For example, we note "51. *Calendarium und Prognosticum auf das Jahr* 1617", which Prof. Caspar has not been able to find. In spite of that, there is half a page upon it. These 'prognostics' Kepler did simply to get bread, because the foolish public would buy them. He condemned bitterly the time spent upon them, as being akin to begging, and scarcely in any way more venial—though he does not seem to have altogether disbelieved them.

After that we have seventy-six entries, or twenty pages, of briefer descriptions of various works of Kepler published afterwards, up to the present day. Then, still more briefly, a list of 224 writings which are about Kepler, or which contain some notable reference to him, also continued up to the present day. Then an alphabetical list (3 pp.) of the works in the first section; then a list (3 pp.) of the libraries quoted, and then four pages devoted to the names referred to. Then, a most valuable section, photographic facsimiles, reduced to fit the page, of all except a few of the title pages contained in the first section. Some of these are in two colours. All this has been done as well as possible, and, of course, costs money. The comparatively low charge to the public is because

Prof. von Dyck was able to allocate funds to this purpose which he had received from the Rhineland industry for investigations relating to Kepler.

Prof. Caspar shows a commendable enthusiasm for his subject, but it seems to us he altogether overrates Kepler as a mathematician. Admitted that Kepler was an outstanding man, a genius in his wild way, and that he had a hard life, and that without courage and strong convictions he would never have discovered 'Kepler's laws'; but because he did so, the world has put him into a niche from which he cannot be displaced. Of course, that happened after his death, when I suppose it did not matter to him how the world treated him. It is no part for this journal to decide whether he was or was not greater than his great contemporaries, Galileo and Tycho Brahe, still less, to step across time and compare him with his predecessor Copernicus and the rest, or his successors, Descartes, Huygens and Newton. But, to take an example—*Harmonices Mundi Libri V*, 1619, contains 'Kepler's third law', which is a very valuable asset; but it also contains a lot of sheer nonsense which no one now thinks of, except to dismiss it, such as the music of the spheres, spelt out in the notes each planet makes, with the remark that the earth utters those notes because misery and famine were found there. No doubt they were; so, too, were the courage and tenacity of a Kepler. Also some things with a less personal point and which we are able to judge impartially, such as the relations of the distances of the planets to the sides of the regular solids. We get no notion at all of this from Prof. Caspar's description. To translate a specimen: "The beginnings of this great work reach back to the earliest adult years, its roots are in the deepest soil of Kepler's thinking. He reveals to us the innermost kernel of his views on Nature and the World, he utters the last word of what he knows how to say of the Cosmos and the position of men. We see here not merely the astronomer . . ." and so forth; all rather rhetorical to our thinking. Although the technical work seems to be well done, this exaggerated language is characteristic. R. A. S.

# The 'Factor School' in Psychology

Ability and Knowledge: the Standpoint of the London School. By Frank C. Thomas. Pp. xx+338. (London: Macmillan and Co., Ltd., 1935.) 15*s*. net.

THE number and character of contending schools of psychology were well brought out a few years ago in a large volume issued in America under the title "Psychologies of 1930". No fewer than eleven schools came under review, one of them being the "Factor School", created by Prof. C. Spearman, and described by him as a school to end schools. That the other schools still flourish—for there is no one of them which does not contain some portion of the truth—does not prove that Prof. Spearman's expectation, or at least his hope, is entirely disappointed. On the contrary it is probably true to say that his theory of a general factor (the now rather famous *g*) and of a variety of specific factors in ability holds the field more securely than ever; and it is equally true to say that his analysis of the birth and growth of knowledge places the psychological study of cognition on a more scientific footing than has ever existed before. After reading Spearman, one can scarcely resist the conclusion that the time has come when William James's lament that psychology was no science, but only the hope of a science, is no longer justifiable.

Prof. Spearman's large books, however, and his extensive series of contributions to learned journals, make heavy going for many people who are not professional psychologists, but who yet desire a statement, which shall be clear without being superficial, of the steps of his argument. Such readers are numerous, and they include, in particular, workers in the fields of education, vocational guidance, and industrial psychology. For them, Mr. F. C. Thomas has written this excellent handbook.

In this book Mr. Thomas really takes up the position of a teacher who, having mastered his subject, takes a keen interest in presenting its essentials with all the lucidity of which its nature admits. We observe that Prof. Spearman and Prof. F. A. P. Aveling, to both of whom Mr. Thomas acknowledges his indebtedness as their former pupil, are abundantly satisfied as to the accuracy of the book as a statement of their joint position. Further, we believe we can answer for it that the readers whom Mr. Thomas has specially in view will be equally satisfied. He modestly disclaims any but "the most ordinary literary facility". We can certify, however, that the book is so well written that not once have we been compelled to re-read a sentence in order to be sure of its meaning.

**(1) Bird-Lovers' Manuals**
How to Know British Birds. By Norman H. Joy. Pp. 136+40 plates. Birds of the Green Belt and the Country around London. By R. M. Lockley. Pp. xix+236+4 plates. 5s. net each.

**(2) The Birds of the Firth of Clyde:**
including Ayrshire, Renfrewshire, Buteshire, Dumbartonshire and South Argyllshire. By John Morell McWilliam. Pp. 164+10 plates. 12s. 6d. net.
(London: H. F. and G. Witherby, 1936.)

THE house of Witherby, under the direction of a distinguished ornithologist, is justly renowned for its bird-books, both technical and popular. Two of the works named above belong to a new series of "Bird Lovers' Manuals" which seem likely to have a wide appeal.

(1) Dr. Joy's volume is a handy work of reference, intended primarily as an aid to identification. To this purpose it is admirably suited. Emphasis is laid on distinguishing characters rather than on general descriptions, and the value of song and call-notes in this respect is recognized. The numerous illustrations are well designed for their particular aim, and make the book very good value indeed for its modest price. Mr. Lockley's volume is a guide to bird haunts in the neighbourhood of London. Each chapter deals with a particular type of habitat, ranging from chalk country to salt marsh, from orchard and park to heather and pines, and pleasantly describes its characteristic bird-life. Actual localities are named, even means of getting there being indicated, and the book should prove very helpful to many who wish to explore the home counties in search of birds.

(2) Mr. McWilliam's book fills a gap among the local faunistic studies of its kind. It gives a straightforward and useful account of the occurrence of different species in the Firth of Clyde and the counties bordering it: the area, of course, includes the great sea-bird nursery of Ailsa Craig.

**Das Zooplankton der Binnengewässer:**
Einführung in die Systematik und Ökologie des tierischen Limnoplanktons mit besonderer Berücksichtigung der Gewässer Mitteleuropas. Von Prof. Dr. W. M. Rylov. (Die Binnengewässer: Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten, herausgegeben von Prof. Dr. August Thienemann. Band 15). Pp. x+272+30 plates. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1935.) 30 gold marks.

THIS work should perhaps have been entitled "Introduction to the Study of the Zooplankton". It is essentially a book for the student or one about to embark upon some limnological problem, and in these cases it should prove of the greatest value.

In the general introductory chapter, as well as in the sections dealing with the main groups of planktonic animals, there will be found in outline the present-day knowledge of such problems as reproduction, food, adaptations and vertical and horizontal distribution of the freshwater zooplankton. There is given, too, a brief introduction to the question of seasonal form variation and to the hypotheses of Wesenberg-Lund, Ostwald and Woltereck. References to a full literature list enable any particular aspect to be pursued in greater detail. Finally, the diagnostic keys, descriptions and plates of only those animals most likely to be encountered will greatly facilitate the task of sorting and identifying collections made in the field.

For the more advanced worker the book is naturally of less value, since the greater part is devoted to systematic descriptions of the commoner Rotifera, Cladocera and Copepoda of the plankton. The list of synonyms (pp. 221–224) is of service to those whose interests are only secondarily systematic. From it they will learn, surely with regret, that the genus *Keratella* disguises such characteristic rotifers as *Anuræa cochlearis* and *An. aculeata*, and that the latter now becomes *K. quadrata*.

**General Chemistry:**
an Elementary Survey; emphasizing Industrial Applications of Fundamental Principles. By Prof. Horace G. Deming. Fourth edition, rewritten and revised. Pp. xiii+774. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 17s. 6d. net.

PROF. DEMING's popular text-book has been extensively revised in its new edition, and many new sections have been added. It now contains brief, but accurate, accounts of numerous modern physicochemical topics, such as photochemistry, the Raman effect, atomic structure and valency (Chapter xxiii), activity theory of electrolytes and *p*H values. The industrial sections have also been revised and amplified to take account of modern practice.

Although the interest and value of the book have been greatly increased, its appeal to the more elementary student is lessened. The reviewer is not altogether in sympathy with the plan of introducing unbalanced equations in the earlier part of the book, as this will encourage a habit which teachers find it hard enough as it is to eradicate among students. Balancing equations should be taught as soon as they are used.

Prof. Deming's book, although it does not fit in with any English course, will be found very interesting and suggestive by teachers.

**The Self in Psychology:**
a Study in the Foundations of Personality. By A. H. B. Allen. (Psyche Monographs, No. 5.) Pp. 282. (London: Kegan Paul and Co., Ltd., 1935.) 10s. 6d. net.

MR. ALLEN, with whom we are familiar as the author of "Pleasure and Instinct", gives us his views on the relation of the self to psychology. Many of the moderns will find it difficult to accept his definition of psychology as the natural history of the *conscious* experience of *men*. Are the rest of the animal kingdom to be denied any consideration under the caption psychology? That the study of subjective experiences is the sole province of psychology, and that those phenomena which are only open to inspection by another observer are not to be included seems to us an alarming doctrine, to say the least of it.

# Indian Conjuring

By Lieut.-Colonel R. H. Elliot, late I.M.S.

THERE is a widespread belief among British people who have not visited the East that India is the 'home of mystery'. I have come across not a few men and women in high and responsible positions who share this erroneous idea. In 'the dim red dawn of man' every strange natural phenomenon was ascribed to the supernatural. Slowly but surely knowledge grew, explanations displaced superstition, and reason, greatly daring, trespassed more and more on the once undisputed domains of the gods, with the result that one mystery after another was resolved by the onward march of common sense. The area of the 'supernormal' has steadily shrunk, and is daily still shrinking. The discovery of facts has always preceded the explanation of their causal origin. There are many things which still puzzle us; we have no valid explanation for them; we freely admit our ignorance and wait for the advance of the tide of knowledge which we believe will sweep on irresistible and ever progressive, washing out as it goes the ripples on the sands of ignorance.

In the early days of our colonization of the East, men watched with wonder the fearlessness with which the Indian snake-man handled his dangerous pets. They saw 'the mango trick', the disappearance of the girl from the basket which was stabbed in every direction by a sword, and the speedy return of the young woman unharmed at the bidding of her master. Then there was the duck, which bobbed at every word of command, answering by the number of its bobs the questions of the performer, and so on. At first the European looked on at these and at a number of other wonders of the same kind, and following the line of least resistance, ascribed the phenomena to mysterious causes which were beyond finding out. As time went on, men who had been imbued with an interest in conjuring before they left 'home', started to study the 'tricks' which had obtained so wide a fame. To their surprise they soon found that conjuring as practised in the East was dependent on the very same factors which governed the art they had learnt at home.

The veil of mystery which had shrouded the Orient was little by little lifted to expose trickery, misdirection and humbug. There was, however, one great difference. In the West, the performer made no bones about the fact that he was deceiving his audience, whilst the Eastern always claimed supernatural powers for himself. Around all his doings he threw a veil of mystery; he was and is a past-master in the art of humbugging his clientele; he never allowed one of his tricks to be taken as a laughing matter; his whole technique was that of the 'priest of mystery'; the matter was a very serious one, no matter how trivial the 'experiment'—he would not have it called a trick for anything—might be.

Step by step our people unravelled the mysteries, dragged them into light and saw them in all their pitiful fraudulence, until it became clear that the fact that a man has a brown, black or yellow skin, and lives in far-away parts of the earth little known to the majority of us, gives him no claim whatever to mystery. Man is man wherever you may find him; his powers are as limited in China as in Chiswick, in Tibet as in Tooting. Nearly 2000 years ago Tacitus coined the phrase "omne ignotum pro magnifico", a dictum which has pricked the bubble of many a mystery. The wonderful 'mango trick' is based on such barefaced deception that were a performer to present it before the "Magic Circle" at one of our monthly meetings, he would be laughed off the stage. The marvellous nodding duck is dependent on a principle so elementary that my grandson of eleven years of age—a budding magician—would hesitate to use it, unless it were combined with other methods which would help to conceal the fraud. The earthenware medallion, on which the Christian is invited to inscribe the symbol of his faith, with the result that though the disk is ground to powder beneath his foot, the cross is found imprinted on his hand, suffices at first to astonish the subject of the experiment, until he has had time—provided he has the intellect—to solve the very simple device which led him astray. The wonderful seer who reads your fortune in the sand tells you things which seem supernatural in their source, unless you realize that your personal servant has been impanelled to help deceive you. Your conversation has been listened to, your letters read and the information so gained has been handed to the 'holy man' in exchange for the receipt of a small coin of the realm. One might go on with a number of other 'tricks'; and please note that 'tricks' they are, nothing more and nothing less.

At the present time, most sensible people know all about the majority of these wonders of the East, but two remain to puzzle and disconcert a number of our fellow-countrymen, even including some who have spent the best years of their lives

in the East. I refer to the 'Rope Trick' and to 'Levitation'. The Occult Committee of the Magic Circle, a Committee of which I have the honour to be chairman, spent a great deal of time sifting the evidence in favour of the former performance, for which supernatural origin has been so freely claimed. At a meeting held in London on April 30, 1934, with the late Lord Ampthill, a former acting-Viceroy of India, in the chair, we submitted a résumé of the evidence which we had collected. Lord Ampthill said that during his viceroyalty he had tried hard to see the 'rope trick', but in vain. Similar evidence had been sent us by letter from the late Viceroy, Lord Irwin. Lord Meston, the Right Rev. the Bishop Welldon (formerly Metropolitan of India), Sir Michael O'Dwyer and others supported Lord Ampthill, whilst the last-named mentioned that he had asked the Nizam of Hyderabad if he could help him, but though probably the most powerful prince in India, His Highness could not do so. Those who are interested in the subject will find it fully discussed in the second and third chapters of my book "The Myth of the Mystic East" (Blackwood).

No better illustration could be given of the way in which evidence in favour of this trick has been adduced than the statement made by a correspondent in the *Western Morning News* of November 29, 1934, who wrote as follows: "According to a correspondent, the Indian Rope Trick was performed before several hundreds of men who landed in India from Her Majesty's troopship Malabar. It was performed several times a day, not in bad light or when it was dark, but in the full light of the Indian sun. The Duke of Connaught watched the performance sitting on his horse and seemed highly interested." This story, so circumstantially told, seemed as if it must be true, but I had the privilege of being able to submit it to His Royal Highness, through the kindness of a member of his staff, and this is the reply I received: "With reference to the enclosed letter from Colonel Elliot, I sent it to the Duke. Quoting from his letter, he says: 'After these many years I am unable to remember small events of that time, but I have no recollection of ever having seen the rope trick during my service in India, or even heard of it.'" It is impossible to believe that His Royal Highness would ever have forgotten such a supernormal happening. I am greatly in His Royal Highness's debt for so graciously answering my question. It serves to show the way in which the names of our Royal Family are used behind their backs, in a manner which it is very difficult for them to resent. Their outstanding popularity carries great weight with the public, and leads many people to accept stories as ridiculous as this.

There are two recent incidents which deserve a brief mention. The first of these was the so-called 'Cheltenham Rope Trick'. A gentleman who styled himself "Professor" declared that he had discovered how to perform the 'Indian Rope Trick', and had actually done it before a meeting of a society of conjurers. This statement was widely advertised in the Press, and a local photographer stated that he had photographed a girl "as she reached the top of the rope—but when he developed the film, to his amazement, no trace of the girl was to be seen. The rope was bare". I took some trouble to run this story to earth, and was in communication with officials of the society, and with a gentleman of undoubted honesty who was present at the meeting in question. What did it all amount to? It was just a joke at the expense of the local press-man. A wire had been suspended between the tops of two tall trees, a rope was hung from this, care being taken so to arrange the light that the wire was not visible, and the dupe was told that just before his arrival a girl had ascended the rope and disappeared. The members of the society were much annoyed at the publicity that this trick had attracted and were very unwilling that more publicity should be given to it than they could help. I had to fall in with their wishes. Measures had been taken to prevent any further absurd claims being made. All the same, from time to time notices appeared in the Press, dealing with this incident as if it were worthy of credence instead of being the joke—perhaps not in the best of taste—that it was. My son sent me a copy of it from an Indian paper in which it was taken seriously.

There remains the 'Plymouth Demonstration of the Rope Trick' by Karachi, who, by the way, in private life was a Mr. Arthur Darby. There can be no doubt that a number of honest witnesses, who, however, had not had the benefit of a training in conjuring, were taken in by Karachi, who was simply performing a conjuring trick, which some people have thought very clever, but which to those of us who have studied conjuring was a very cheap form of deception. Mr. Harry Price exposed it in the *Listener* (January 16, 1935), and there was a lot of correspondence on the subject, much of which called to mind Carlyle's bitter dictum on the subject of the intelligence of the population of Great Britain.

The other much disputed topic is that of the power of Oriental fakirs to practise 'levitation'. Many years ago, Messrs. Maskelyne put on a show in which a girl was apparently suspended in midair lying horizontally. Hoops were passed round her in various directions to show that there were no mechanical aids to her flotation. It need

scarcely be said that it was simply a clever piece of illusion. The Eastern magician presents a similar trick, and much has been made of it in a recent issue of the *Illustrated London News*. Many Europeans have seen this clever performance, but some at least of those who have described it have not been very skilled observers. What actually occurs is substantially as follows: The girl lies on the ground and is covered up; a sort of tent is built round her; then under cover of it she is raised up; the tent is gradually taken away bit by bit, until she is seen lying suspended as it were above the ground, but with some of her coverings dropping down to the ground near her head end in what appears a very innocent way. The spectator is not allowed to go up and examine this drapery or he would find out that it conceals an iron post driven into the ground. Were he allowed further license, he would soon discover the secret of the trick, which indeed is very similar to the device used by Maskelyne long ago. An Indian civilian who occupied a high position in the country recently wrote to me describing how he had this trick performed in his compound at a garden-party. Among his guests was a well-known bishop who was greatly troubled by what he took for a satanic manifestation, until the Commissioner asked him how the man described his performance. "As a trick," replied the bishop. "Well, if he only claimed for it that it was a trick you may be sure it was nothing more. He would certainly not err on the side of modesty in his claims."

In reading of, or in listening to descriptions of this trick as given by men who have not had a training in conjuring—the art of suggestion and misdirection—I would urge readers to be very sceptical. They are often misled to think that events happened far differently from what they actually did. Time after time I have heard people describe what they thought they saw, and knowing how the trick was done I have been astonished that they can have been so hopelessly misled as to the real facts. The success of any and every conjuring show depends on this factor of deception.

We read and hear wonderful descriptions of *yogis* buried alive and being none the worse for it. In those cases in which expert conjurers have witnessed such experiments, it has been quite clear that the actual conditions were not those claimed by the performer. By means well known to expert magicians—I use the term without prejudice—the suffocation of the subject was easily avoided, though doubtless the experience was sufficiently unpleasant. I know the wonderful claims that have been put forward, but I have so often had the opportunity of checking such claims by careful observation and discovering their worthlessness that I am very far from being convinced.

Once again I would urge readers to look always for a natural explanation of any phenomenon, and when one is not forthcoming, to await the advent of more knowledge, confident that a normal and not a supernormal explanation is always forthcoming, provided that we have the requisite knowledge.

# American Early Tertiary Mammals

THE White River formation of western North America contains numerous well-preserved fossil skeletons of mammals which date back to Oligocene times when some present-day families were beginning to flourish. The rocks seem to have been formed by floods on a very extensive plain, where the carcases of animals which lived under varied conditions were washed together repeatedly during a long period. The fossils therefore give a very good idea of the mammals which were living on the North American continent during a particularly interesting episode in the evolution of mammalian life. They have already been described in numerous scattered works and papers, but modern methods of collecting have provided so many more satisfactory specimens that there is now an opportunity for a comprehensive review of the whole fauna.

Such a review is being undertaken by Prof. W. B. Scott and Prof. G. L. Jepsen, of Princeton University, who have just published the first part of their work dealing with the Insectivora and Carnivora*. None of the Insectivora has the vacuities in the bony palate and the incompleteness of the zygomatic arches which characterize some existing Insectivora, so that these must be regarded as degenerate, not primitive features. Of the Creodonta or earliest Carnivora, only some Hyænodontidæ survive in the American Oligocene, but very fine skeletons have been obtained from the White River formation. The authors are as much puzzled as previous investigators to explain the use of the long passage above the palate of

* The Mammalian Fauna of the White River Oligocene. Part 1. Insectivora and Carnivora. *Trans. Amer. Phil. Soc.*, N.S., 28, Part 1. Pp. ii+153+22 pl. (Philadelphia: American Philosophical Society; London: Oxford University Press, 1936.)

*Hyænodon* by which the internal nostrils are displaced as far backwards as those of a crocodile. They remark that "there is no other feature in the teeth or skeleton of the hyænodonts to suggest amphibious habits". They also point out that *Hyænodon* cannot have fed on ants like the existing ant bear (*Myrmecophaga*), which exhibits a nearly similar arrangement of the palate.

The beautifully preserved skeletons of Canidæ or dogs are especially interesting, because they show that in Oligocene times the family was not so completely distinguished from other Carnivora as it is at present, while one genus, *Daphænus*, seems to be the common ancestor of at least three distinct groups of modern Canidæ. The smaller Oligocene dogs must have looked much like civets.

There are very few Mustelidæ in the White River formation. This family seems to have been much more characteristic of the Old World than of the New World during Oligocene times. Of the Felidæ, no true cats have been found in North America before the Pliocene, but the sabre-tooth cats or Machairodontinæ are well represented in the White River formation. They are all much smaller than the familiar 'sabre-toothed tiger' of later date, but it is interesting to observe that the articulation of the lower jaw in the Oligocene genera is as completely adapted for the wide opening of the mouth as it is in the latest Pleistocene genera. There is no doubt that the sabre-shaped canines were used for stabbing; and one skull of *Nimravus* in the museum of the Dakota State School of Mines exhibits a large gash in the brain-case that was evidently made by such a stab.

From this brief summary it is clear that Prof. Scott and Prof. Jepsen are doing much more than providing technical descriptions of the fossils. They are publishing an illuminating treatise on Oligocene mammals, of which the succeeding parts will be eagerly awaited. A. S. W.

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# Daniel Gabriel Fahrenheit (1686-1736)

AMONG the many improvers of the thermometer in the eighteenth century, none laboured more assiduously or successfully than Daniel Gabriel Fahrenheit, the German natural philosopher and instrument maker who died in Holland at the early age of fifty years on September 16, 1736. His work was done at a time when the physical and medical sciences were making rapid advances, and there was great need for thermometers of good construction and furnished with a standard scale which could be used for comparisons. It was this need that Fahrenheit met. He was not the first to make thermometers, the first to use alcohol or mercury, or to devise scales with fixed points, but his improvements were such as to make his thermometers known all the world over, and though to-day it is generally recognized that the universal use of the centigrade scale would be a great advantage, the Fahrenheit thermometer seems likely to remain in use for many years yet.

For nearly a century before Fahrenheit's time, men of science had been using thermoscopes and thermometers, and a grand array of names is associated with their early history. Galileo, Boyle, Huygens, Hooke, Halley and others all contributed to the progress of thermometry. Doctors were especially interested in thermometers by which the temperature of human beings and animals could be taken, while natural philosophers required thermometers as much as barometers. The term 'thermometer' is first mentioned by the French Jesuit, Father Leurechon (1591–1670), in his "Récréation mathematique" published in 1624. The early instruments were subject to changes in atmospheric pressure and were really 'baro-thermoscopes'. Ferdinand II, Grand Duke of Tuscany (1610–70), founder of the Accademia del Cimento at Florence, was the first to produce a thermometer unaffected by atmospheric pressure.

There were all sorts of ideas regarding the graduation of thermometers. In 1665 Boyle suggested the freezing point of aniseed oil, and Huygens in the same year suggested as fixed points the freezing point and boiling point of water. Snow in very cold weather, the greatest heat in summer and melting butter were also proposed for definite temperatures. There were also many suggestions regarding scales, about a score of scales being used in the eighteenth century, of which, however, those due to Fahrenheit, Réaumur and Celsuis, or perhaps more correctly Martin Strömer, alone survived.

It is well known that Fahrenheit was the first to bring the mercurial thermometer into general use, that he devised his well-known scale about 1714, and that he described his method of making thermometers in five short papers in Latin to the Royal Society in 1724, but it is not generally known how he came to be an instrument maker. The bicentenary of his death, however, has led to the publication of a biographical memoir in the *Transactions of the Royal Academy of Sciences of*

*Amsterdam*, the authors of which, E. Cohen and W. A. T. Cohen-de Meester, add a great deal to our knowledge of Fahrenheit's personal history. This memoir shows Fahrenheit in a most pleasing light, gleaning information from many sources, writing and lecturing on such things as hydrostatics, optics and chemistry, and consorting with some of the most learned men of his time. Of special interest in this memoir are the references to some letters not long ago discovered in Leningrad. In one of these, written on April 17, 1729, to the famous physician Boerhaave, Fahrenheit tells of a visit in 1708 to the Danish astronomer Römer, whom he found placing thermometers in a mixture of ice and water and in blood-warm water. Inspired by his contact with Römer, Fahrenheit began to read about barometers and thermometers and studied the memoirs of Maraldi, de La Hire and Amontons in the publications of the Paris Academy of Sciences. Of the writings of British physicists, he knew only of Boyle's works, so far as they had been translated into Latin, as it was not until his visit to England and his election into the Royal Society in 1724 that he studied English.

Born in Dantzig on May 24, 1686, Fahrenheit was the eldest of a family of three boys and two girls, who were left orphans in August 1701 by the accidental death of both father and mother. He was sent by his guardian to Amsterdam to a merchant's house to learn business, and as a young man made journeys into Denmark, Sweden, Germany and Russia, probably settling finally in 1715 in Amsterdam, where by his lectures he stimulated the study of physical science and where he constructed the thermometers for which he will always be remembered. In 1736 he secured a patent for a mill for draining purposes but did not live to reap any benefit therefrom. His death took place at The Hague, and four days later he was buried in the Kloster kirke, the register of which contains the entry "Am 20 September 1736 am Tage begraben in dem Gewölbe unter dem Chor Daniel Gabriel Fahrenheit. Für Miete des Grabes und zwei Läuten 18 Gulden".

The memoir on Fahrenheit to which reference has been made above contains portraits of several of his most celebrated contemporaries, including Boerhaave, Römer, s'Gravesande, Musschenbroek and Nieuwentyt, but none of Fahrenheit himself.

# Obituary

## Mr. William Rintoul, O.B.E.

MR. WILLIAM RINTOUL died at the age of sixty-six years at his home in Ardrossan, Ayrshire, on August 25, after nearly a year's illness. His career had been a remarkable one, and began in Glasgow, where he was educated and received in Anderson's College his scientific training. In the late 'eighties there were (as there are even now) few schools of analytical chemistry, so that Mr. R. R. Tatlock not only filled the post of city analyst but also himself lectured and had a staff of lecturers on chemistry and physics to students many of whom afterwards became his assistants and later occupied important positions in the chemical profession. Ramsay was one of them.

After a short time as an assistant, Rintoul lectured to Tatlock's students until in 1891 a post of chemist offered in a paint manufacturer's near London, where he got chemical and works experience. After three years there he went in 1894 to the Royal Gunpowder Factory as a chemist in the laboratory, later becoming chemist-in-charge of the manufacture of nitroglycerine, and for two years before he resigned he was chief chemist in the laboratory.

At this time the Royal Gunpowder Factory under Sir Frederic Nathan as superintendent and Mr. James Thomson as manager led the explosives industry in Great Britain in organization, in safety precautions and in the invention of new processes and plant. Rintoul, naturally inventive and of remarkable manual skill, did his full share, of which the displacement process for the manufacture of nitroglycerine is an example. This process improved the manufacture of that explosive economically in that no high buildings were required to house the plant and also from the point of view of safety, as the nitroglycerine was removed (by upward displacement) from its acid mixture as soon as it had been formed and was sent at once for its preliminary washing, instead of being left to separate in bulk in an acid, and more or less dangerous, state. At this time also he was co-inventor with Robertson of a process and plant for the recovery of acetone, the solvent used in the manufacture of cordite.

Accompanying Sir Frederic Nathan to Nobel's Explosives Company (now part of Imperial Chemical Industries, Ltd.) at Ardeer in Ayrshire in 1909 as chief chemist, he became research manager there and devoted himself to the organization of the laboratories and erection of many new ones. His policy had several features which have been commended by others in like position, as for example, the provision that all chemists, whether destined for research or plant, should first undergo a thorough training in analytical chemical methods, the insistence on a good system of documentation of reports and of published work, the installation of physical methods of testing explosives and close contact with the universities.

While at Ardeer he was associated with a number of patents chiefly on stabilizers for explosives, and developed a keen interest in biochemical investigations, some of which are described (with Raistrick) in the *Philosophical Transactions of the Royal Society*.

About ten years ago Rintoul was brought up to the headquarters of Imperial Chemical Industries, Ltd., as a director of its research organization, from which he maintained an active and sympathetic contact with all the company's laboratories, and came into close touch with many prominent scientific men who were working directly or indirectly in the company's interests, for it was part of his duty to administer the support given by the company to widespread scientific activities. In these matters he gained the respect and affection of everyone with whom he came in contact, and as representative of his firm was well known abroad, where he attended many conferences.

Rintoul was made an O.B.E. for his work in the Great War, and assisted on many committees such as the Councils of the Chemical Society and Institute of Chemistry, the Safety in Mines Research Board, the Chemistry Research Board (D.S.I.R.), the Research Committee of the Midland Railway and the British Standards Institution. When he died he was president of the Faraday Society, in the discussions of which he took much interest.

Rintoul married twice: first Lottie Edwards, by whom he had two sons and a daughter, and secondly, two years ago, Jess Isabel Robertson.

R. ROBERTSON.

## Dr. N. A. F. Moos

To those interested in terrestrial magnetism and in Indian science, the name of Dr. Nanabhai Ardesher Framji Moos is well known, and they will learn with regret from *Current Science* for June of his death on March 12 last. Born in 1859, he graduated in engineering at the Poona College of Science in 1878, and after some years of teaching there entered the University of Edinburgh, taking the B.Sc. degree with distinction in 1886. On his return to India he held a series of appointments, including that of professor of physics at the Elphinstone College, Bombay.

At that time the observatory at Colaba, Bombay, was in charge of Mr. C. Chambers; and on his death, in 1896, Moos was appointed director, soon having the responsibility of overcoming the disturbances produced in the magnetic records by electric traction in the city. He shifted the magnetic work to a new observatory at Alibag, where he was most successful in handling the architectural difficulties of a constant-temperature room.

Moos had all the faithful conscientiousness that is found in Indian officers, and to that he added much of the Parsee energy and enterprise. His training in engineering, as well as in physics, gave him considerable interest in instrumental design, so that he loved to work out new patterns in seismometers. But his outstanding feature was his devotion to the observatory. He was ever on the look-out for new apparatus, and was determined that, if he could bring it about, the equipment of Bombay should not be inferior to that of any observatory in the world. For the financial difficulties of those in administrative charge, his sympathy was, not unnaturally, somewhat restricted; but in spite of an occasional disappointment his loyalty to his work never flagged.

Moos's great opportunity came with the plan for putting together and discussing the complete series of observations of the old Bombay Observatory; and the two volumes of "Colaba Magnetic Data, 1846–1905" are a monument of conscientious and successful labour. They form an indispensable part of the equipment of a magnetic library.

Moos had always taken a keen interest in the university life of Bombay, and after his official retirement in 1919 his active participation was kept up until the end.

G. T. W.

## Mr. J. L. Hodgson

MR. JOHN L. HODGSON died on August 14 at his home near Leighton Buzzard, at the early age of fifty-five years. Born at Lincoln and receiving his technical training at Nottingham University College, he leaves a life record of very valuable work in the engineering world. On the practical side, he served with Messrs. William Walker, the Gedling Colliery, Yarrow and Co., where he was associated with the late Sir Alfred Yarrow in research work on speed ships and destroyer design. About 1910 he was appointed to the staff of George Kent Ltd., of London, and became the technical adviser on all matters connected with the metering and control of air, gas and steam. It was he who designed the first Venturi air meters, which were installed by the Victoria Falls Power Co. He was also intimately concerned with the ventilation arrangements of the Mersey Tunnel. For one of his papers dealing with the use of the orifice for the measurement of fluid he was awarded the Telford Medal by the Institution of Civil Engineers.

Throughout his life, Hodgson abhorred waste in all forms, believing that scientific discovery and invention should be used for the service of man, and not for his destruction. He was one of the founders of the Engineers' Study Group, which was formed to study how and why there is "poverty amidst plenty" in our age. His death will be a severe loss to many friends.

WE regret to announce the following deaths:

Dr. Alexander Anderson, formerly president of University College, Galway, on September 5, aged seventy-eight years.

Mr. E. R. Deacon, O.B.E., head of the high explosives branch of the Directorate of Explosives Research, Woolwich, on August 29, aged fifty-four years.

Lord Moynihan, emeritus professor of surgery in the University of Leeds, and president in 1926–32 of the Royal College of Surgeons of England, on September 7, aged seventy years.

# News and Views

### The British Association and Social Science

THE Report of the Council of the British Association, adopted by the General Committee on September 9 at Blackpool, included two matters of particular interest relating to the development of the activities of the Association in the field of the social sciences. During the year covered by the Report, the Council appointed a Committee to consider how the Association might indicate the importance which it attaches to the development of the social sciences, either by the appointment of a third general secretary or by other appropriate means. As a result, this year's programme includes in a separate section the titles of addresses, papers, and discussions having a special bearing upon the relations between science and the interests of the community. Communications appropriate to this group may be suggested by organizing sectional committees or by sectional presidents. At least one discussion in each annual programme is to deal with the application of science to social problems, and at least one of the evening discourses. By these developments, it is intended to provide the evidence which public opinion now demands that the Association shall carry out one of its original aims, namely, that of "obtaining a more general interest for the objects of science".

### Incorporation of the British Science Guild

IN the same spirit, the General Committee accepted the recommendation of the Council for the incorporation of the British Science Guild in the Association. It will be remembered that the Guild was the outcome of Sir Norman Lockyer's presidential address to the Association, at the Southport meeting thirty-three years ago, on "Influence of Brain Power on History". The stated object of the Guild is "to promote the application of scientific method and results to social problems and public affairs". As is pointed out in the Report adopted at Blackpool, the same object is implicit in the aims of the Association; and the programmes of recent meetings have given evidence of a greater concern for these problems than was commonly exhibited in former years. The terms of the incorporation of the Guild in the Association include the transfer of the capital funds of the Guild to the Association, together with contingent bequests from Lady Lockyer and Sir Albert Howard. The Council of the Association will appoint a committee, to be called the British Science Guild Committee, which will be entrusted with arrangements for lectures already initiated by the Guild and for any similar lectures approved by the Council. The Norman Lockyer Lecture is to continue to be delivered annually and to have particular reference to the relations between science and the welfare of the community; and the Alexander Pedler Lecture is to be offered annually to one of the corresponding societies of the Association, or be delivered at a centre outside London. The amalgamation of the two bodies was greatly to be desired, and we are glad that it has now been accomplished. Though, when the Guild was founded, few men of science took active interest in the application of scientific methods to the investigation of social problems, there is now a decided change of attitude in this respect and the columns of NATURE have afforded abundant evidence of such repercussions. The Association has responded to this extended influence, and has thus shown itself to possess the progressive spirit which should be characteristic of every scientific institution.

### Jean-Sylvain Bailly (1736-93)

THE bicentenary of the birth of the French astronomer Jean-Sylvain Bailly, who was born in Paris on September 15, 1736, and perished on the scaffold at the age of fifty-seven years, recalls a career of great interest, for Bailly was not only a cultivated and distinguished man of science, but he was also one of the enthusiastic philanthropists who at the coming of the French Revolution adopted with ardour the popular cause and endeavoured to secure for the people sound constitutional reforms. The son of a keeper of the King's pictures, it was intended that he should follow in his father's footsteps as a painter, but literature proved more attractive than art, and science more alluring than either. It was his acquaintance with Lacaille that led him to astronomy, and one of his earliest labours was the reduction of Lacaille's observations on zodiacal stars. He also became known for his researches on Jupiter's satellites, but his greatest work was his "Histoire de l'Astronomie", a work full of animated description, luminous narrative and interesting detail. The correspondent of Voltaire and Buffon, the contemporary of D'Alembert and Diderot, Bailly's versatility was recognized by the unusual honour of his being elected a member of the Academy of Sciences, the French Academy and the Académie des Inscriptions et Belles Lettres.

ALL accounts of Bailly describe him as a man of the highest integrity, generous, courageous and liberal-minded. The popularity he enjoyed led to his election in 1789 as a deputy to the Tiers-Etat and to his being chosen president of the National Assembly. In his capacity of president he dictated to the members the oath taken in the Tennis Court at Versailles on June 20, 1789, "to resist tyrants and tyranny, and never to separate till they had obtained a free constitution". About a month after this, the Bastille fell, and on July 17, when Lafayette was made commander-in-chief of the new National Guard, Bailly was made Mayor of Paris. For two fateful years Bailly held his difficult posts, endeavouring amidst the rising tide of republicanism to serve

both King and country. Then came his fall. On July 17, 1791, the demonstration took place in the Champ-des-Mars to secure signatures for a petition demanding the dethronement of the King. There was disorder and violence, Bailly gave the order for the crowd to be dispersed by force, fire was opened, some forty people killed and with the "massacre of the Champ-des-Mars" Bailly's popularity waned. A few months later, he resigned his posts and retired to Nantes. Two more years passed and against advice he visited Laplace at Melun. He was recognized and denounced, and was sent to Paris, where he was tried on November 10, 1793; on the next day he was condemned, and on November 12—a bitterly cold wet day—was taken in an open cart to the ill-fated Champ-des-Mars and there guillotined amidst the execrations of the people he had done his best to serve. Save for Lavoisier, who fell on the scaffold six months later, Bailly was the most distinguished man of science who fell a victim to the Revolution. He had, however, played a conspicuous and honourable part, and to-day his statue stands in the gardens of the Luxembourg.

### Vitamin $B_1$

THE structure of vitamin $B_1$ was made certain by its synthesis, recently announced from the laboratory of Prof. Williams of Columbia University (see NATURE, Aug. 29, p. 372), and this has now been repeated elsewhere. Grewe (*Hoppe-Seyler's Zeitschrift für physiologische Chemie*, **242**, 89; 1936), working in Windaus's laboratory at Göttingen, describes the preparation of the pyrimidine half of the molecule, and completely confirms the latest formula put forward by Williams, though mention is only made of Williams's earlier suggestions which he himself has now modified. Grewe goes on to state that he had intended to work out a synthesis of the vitamin from the new pyrimidine derivative when he learned, through Prof. Windaus, that Andersag and Westphal had already accomplished this in the scientific laboratories of the I.G. at Elberfeld, and that patent protection had been sought. Prof. Williams's work was carried out with the collaboration of Merck and Co., Inc., Rahway, N.J.; it seems, therefore, on the cards that there may be some interesting developments in the patent field, should the synthesis of vitamin $B_1$ become practicable on a commercial scale.

### Half-Castes and World Peace

A NOVEL view of the problem of the half-caste and of the role which might be played by communities of mixed origin in the promotion of world peace is taken by Mr. Cedric Dover in a memorandum which he presented to the International Peace Congress held on September 3–6. In a cursory survey of the figures, he points out that not only are half-castes more numerous than is realized generally, but that they form an appreciable proportion of the populations of the modern world. Mr. Dover, however, does not rely on the mere weight of number. He goes on to argue that half-caste communities, consisting of 'marginal' men, who represent two cultures, and exist under conditions of 'imperialism', owing to the presence of a dominant white population, present parallelisms, due to a common ethnic element derived from their white blood, a common language (English), a common religious belief, and common social and economic conditions. It is suggested, therefore, that the continued growth of ethnic relations and mixed populations should be accepted as part of the machinery of human evolution, of which advantage should be taken to promote the greater ethnic unity and cultural uniformity, which would afford an efficient counter to an aggressive spirit of nationalism, while the creation of a united front of marginal communities would lead inevitably to better international understanding.

IF Mr. Dover's suggestions to this end tend to a more rational attitude towards the half-caste, they will have accomplished much. Miscegenation, however, has not been overlooked as a possible ultimate solution of the colour question; but the world, it would seem, is not yet prepared, on present evidence of the effects of the crossing of widely diverse strains, to foster it deliberately or even to countenance it. The organization of a world-wide front of sufficient strength to make its weight felt demands resources and machinery, of which at present there seems little expectation. Quite possibly local loyalties would prove obstacles stronger than the communal parallelism upon which Mr. Dover would rely.

### Roman Leicester

A FURTHER stage in the proceedings which will determine the future of Roman Leicester (see NATURE of August 29, p. 356) was reached on September 3, when an inquiry was held in the city by the Ministry of Health to examine the application of the Leicester Corporation to borrow £135,000 for the purpose of erecting baths on the site adjacent to the Jewry Wall, upon which archæological investigations are being conducted by Miss Kathleen Kenyon. The application was opposed by the Leicester Archæological Society, the Leicester Literary and Philosophical Society and the Leicester Civic Society, bodies co-operating in the excavation. They were represented by Mr. Macgregor Clarkson; and Mr. P. K. Baillie Reynolds, Inspector of Ancient Monuments, was also present, representing the Office of Works. In the course of his evidence, Mr. Clarkson stressed the unique position which the site conferred on Leicester. The recent discoveries, he urged, made it possible to point to the civic centre of the city in three historic periods—the Town Hall of Roman times, the Guildhall of the Middle Ages, and the modern Town Hall. Miss Kenyon's evidence dealt with the important archæological features of the site added by her investigations, including part of the Forum and the ten feet depth added to the Jewry Wall, part of the Roman Town Hall, which, now standing at 35 ft. in total height, is one of the largest Roman walls in Britain. This wall is scheduled as an ancient monument.

THE suggestion put forward by Mr. McEvoy, the Town Clerk, in stating the case for the application, was that excavation should proceed under skilled archæological supervision, the cost entailed over and above the normal cost of excavation to be borne by a local committee representing those interested in ancient remains. Against this, Mr. Colin D. R. Elles, the chairman of the excavation committee, handed in a petition, which had been signed by 3,235 persons in four days only, asking that the remains should be preserved; while Mr. Baillie Reynolds not only stated that his department would look with great favour on any scheme to preserve the remains, but also intimated that the Office of Works would co-operate in laying them out to advantage.

### Forensic Medicine

THE Advisory Committee on the Scientific Investigation of Crime, under the chairmanship of Lord Trenchard, recently issued its report (London: H.M. Stationery Office, 1936. 2*d*. net), from which it would appear that the teaching of forensic medicine in London is in an extremely backward condition as compared with the teaching of that subject in most of the capitals of Europe, and well behind the standard set in Scotland. As the Committee points out, this is not confined to the restricted sphere of criminal investigation and police practice, but extends to the study of many problems connected with social medicine and to the whole question of medico-legal practice. The Committee recommends the establishment of a medico-legal institute which would act as a training centre for medico-legal experts and as a centre for special pathological research, and it also suggests that facilities should be given for courses of instruction for students of law, coroners and other persons who are associated with medico-legal work.

As to the question of police laboratories, though in certain circumstances it is no doubt advisable to have laboratory facilities under the direction of the police, the proper place for extensive medico-legal investigations is in connexion with departments of universities. If the investigating authorities are to have the facility of obtaining advice on all kinds of scientific subjects, as they must, there is no possibility of so doing if they are restricted to police laboratories. Such advice and assistance can be obtained only through the universities. It is, however, impossible for the police authorities to know what departments to consult, and therefore a department of forensic medicine within the university offers the only means by which full use of the latest advances in science may be obtained. On considering the whole matter, it would appear to be advisable for the authorities in London to concentrate their efforts in founding a Department of Forensic Medicine in connexion with the University of London, and to make the necessary arrangements for the ample material, which is at present largely wasted, to be utilized in the teaching of elementary forensic medicine to medical students and to offer facilities for post-graduate study and research to those who desire to specialize in this subject.

### Technical College Equipment

WE have received from an Advisory Committee on Technical College Equipment, British Industries House, Marble Arch, London, W.1, a memorandum on a scheme in progress for setting up an exhibition at British Industries House showing the equipment necessary for technical institutions. This movement is designed to help those responsible for expenditure on these centres in view of the very large outlay anticipated during the next few years by the Board of Education. The Committee represents the three associations concerned with technical teaching and also the Institution of Production Engineers, and hence is an authoritative body. It is pointed out that the present method of deciding on a design, that of visiting recent buildings and utilizing the composite information obtained, wastes time and is unsatisfactory. Technical education in Great Britain is lamentably behind that on the Continent in the matter of material equipment and buildings, hence this scheme is to be commended. The relationships of the pieces of mechanism will no doubt be an important part of the Committee's work, though this must be to some extent subservient to the configuration of the floor space. More difficult will be the presentation of the structural features and service supplies essential as the basis of the equipment. It is stated that the object is to enable full information to be obtained for getting out estimates for building, extending, and equipping institutions. So far as the two former functions are concerned, it seems difficult to see how the exhibition can supply any detailed information, from the province of trained professional advisers and necessarily varying with local conditions; such advisers, however, should be able to learn much from the exhibition.

### Geological Survey and Museum: New Activities

A NEW publications stall, where the public may purchase the official guides and geological memoirs, including the series of handbooks on British Regional Geology referred to in NATURE of September 5 (p. 389), has been opened in the entrance hall of the new Geological Museum at South Kensington. The Museum has also published an extensive series of excellent photographic postcards, price 1*d*. each, which are likely to be of value to teachers of geology and physical geography. The postcards include reproductions of general views of the Museum, with dioramas and other interesting exhibits; and photographs of British localities of geological interest, with explanatory text, illustrating marine erosion and sea coasts, rock-weathering and denudation, vulcanism, glaciation, and similar subjects. A list is obtainable from the Museum. An experimental series of free public lantern lectures and lecture tours on the geology and scenery of various regions of Great Britain was given last month. The lectures were well attended, and will be continued throughout the winter. Facilities for special parties can be arranged. Recent additions to the exhibited collections include a series of specimens from H.M. Office of Works, illustrating the weathering of the building stone

(Anston stone) of the Houses of Parliament; and a suite of ores illustrating the occurrence of copper at Kilembe, presented by the Geological Survey of Uganda. This occurrence, which is in granulitic rocks, is remarkable for the presence of the cobalt ore linnæite, although arsenic and antimony are absent. Among the donations recently received by the petrographical department there is a valuable series of rock-specimens from the Pre-Cambrian of the Adirondacks, New York State, collected and presented by Dr. A. F. Buddington of Princeton University; and a second fine collection from the Charnwood Forest and Nuneaton areas, presented by Mr. H. H. Gregory of the Leicester Museum.

**Empire Fauna at Home and Abroad**

THE August number of the *Journal of the Society for the Preservation of the Fauna of the Empire* presents some interesting contrasts in its varied accounts of wild life in different British territories. Capt. C. R. S. Pitman, to whose reports as Game Warden of the Uganda Protectorate NATURE has referred on previous occasions, in a lecture to the Society, explained why organized control of the 21,000 elephants of the Protectorate became necessary. The devastation caused by such great numbers in a limited area (of some 80,000 square miles), where the native population averages forty to the square mile, became intolerable, and yet under organized control, and in spite of the fact that 17,000 elephants have been slain in twelve years, the estimated number remains as it was in 1924. Capt. Pitman is of opinion that organized control is the finest insurance for the adequate perpetuation of the African elephant. From wild Africa we turn to the home of animal protection—and read Miss Frances Pitt's article upon the polecat and pine-marten in Great Britain. The elephants are over-numerous, do serious harm, are deliberately slaughtered, and yet their continued existence is secured; the polecat and pine-marten are rare, are two of the most interesting members of the primitive fauna which survive in Britain, they do no particular harm in any serious degree, and yet—the first is extinct in Scotland and England, and survives only on the Welsh border, and the latter is apparently extinct, or all but extinct, throughout the whole country except in the north-west of Scotland; and almost all because these creatures are liable to find their way into traps set for vermin. It is ironical that while we concern ourselves with the fauna of the Empire abroad, these two creatures should be disappearing in *our* own land under our eyes. Can no step be taken to ensure their adequate perpetuation, as the adequate perpetuation of destructive elephants in Uganda is ensured?

**Marine Biology at Cullercoats**

THE Report for the year ending July 31, 1935, of Armstrong College Dove Marine Laboratory, Cullercoats, Northumberland, drawn up by the director, Prof. A. D. Hobson, and published by the Marine Laboratory Committee of Armstrong College, shows a successful period in the history of the Laboratory. Further alterations in the building have given more working space and the library has been extended, with most satisfactory results. Herring observations have been continued in accordance with those of previous years, also salmon investigations, the results of the latter work having been published in the Annual Report of the Tyne Salmon Conservancy Board. Interesting results have been obtained by Dr. Bull in his experiments on conditioned responses in fishes in connexion with changes of salinity, and he has also continued his observations on pollution in the Tyne estuary. Faunistic work, which has been made a speciality of the Laboratory researches, is progressing rapidly, many new additions have been made to the fauna, and a reference collection is in process of formation which will be of great value to future workers. A mussel survey of the Northumberland beds has been completed, and a report prepared and submitted to the Northumberland Sea Fisheries Committee. This report appears in the present publication, showing that the Holy Island and Budle Bay beds are the only areas of importance for bait supplies. Papers on the herring investigations by B. Storrow and Dorothy Cowan, on conditioned responses in fishes (Part 6) by H. O. Bull, and on heterogonic growth in the abdomen of *Carcinus mœnas* by J. H. Day (see NATURE, April 18, 1936, p. 669) are also included.

**Weed Problems in Australia**

As in some other parts of the world, noxious weeds are proving a serious source of trouble in Australia. The problem has been under the consideration of the Standing Committee of Agriculture and independently by several of the bodies represented on it. An arrangement was made in 1934 that as a preliminary to further work an officer of the Council for Scientific and Industrial Research should undertake a survey of the problem, the economic importance of different weeds, methods of control which had been already tried and their results, and so forth; his report to include recommendations for further co-operative work. The survey was undertaken by Mr. G. A. Currie, of the Division of Economic Entomology, assisted in certain aspects by Mr. J. Calvert, of the Division of Plant Industry. The report has been recently drawn up by Mr. Currie, and the more important portions of it are published by the Council for Scientific and Industrial Research of Australia in Pamphlet No. 60, "A Report on a Survey of Weed Problems in Australia" (Melbourne: Government Printer, 1936). Apart from the study made of past records of the activities and damage resulting from weeds, the weed legislation of each State was studied and the methods of administration ascertained. The pamphlet outlines the losses incurred from weeds, and the existing methods of control and the relation of dangerous weed growth to various primary industries. There is much in this pamphlet which could be studied with advantage in Great Britain. Among the sixteen weeds selected as being the most important in Australia are such well-known ones as bracken, stinkwort, thistles, blackberry, St. John's wort, lantana, ragwort, convolvulus and wild turnip.

(*Continued on p.* 458.)

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SUPPLEMENT

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# The Impact of Science upon Society*

By Sir Josiah Stamp, G.C.B., G.B.E., F.B.A., President of the British Association

DURING the past year we have had to mourn the loss of our patron, King George V, but to rejoice in the honour done us by His Majesty King Edward VIII, himself our most illustrious past-president, in taking that office.

Since the beginning of this century the British Association has, till now, added only one new place of meeting in Great Britain to its list. Blackpool can certainly do for science in the North all that Bournemouth achieved in the South: give our record new vigour, and itself a new friend.

The reactions of society to science have haunted our presidential addresses with various misgivings for some years past. In his great centenary address General Smuts, answering the question "What sort of a world picture is science leading to?", declared that one of the great tasks before the human race is to link up science with ethical values and thus remove grave dangers threatening our future. For rapid scientific advance confronts a stationary ethical development, and science itself must find its most difficult task in closing a gap which threatens disruption of our civilization, and must become the most effective drive towards ethical values. In the following year a great engineer spoke as a disillusioned man, who watched the sweeping pageant of discovery and invention in which he used to take unbounded delight, and concluded by deploring the risk of losing that inestimable blessing, the necessity of toil and the joy of craftsmanship, declaring that spiritual betterment was necessary to balance the world. Then came the president of the Royal Society, a supreme biochemist, on the perils of a leisure made by science for a world unready for it, and the necessity for planning future adjustment in social reconstructions. Followed the astronomer, deploring man's lack of moral self-control; in knowledge man stands on the shoulders of his predecessor, whereas in moral nature they are on the same ground. The wreck of civilization is to be avoided by more and not by less science. Lastly, the geologist gloried in the greatest marvel of millions of centuries of development, the brain of man, with a cost in time and energy that shows us to be far from the end of a mighty purpose, and looking forward confidently to that further advance which alone can justify the design and skill lavished on such a task. So the geologist pleads then for scientific attention to man's mind. He has the same faith in the permanence of man's mind through the infinite range of years

> "That oft hath swept the toiling race of men
> And all their laboured monuments away",

that is shown at the Grand Canyon, where, at the point exposing, in one single view, over a billion and a half years of the world's geological history, a tablet is put to the memory of Stephen Tyng

* PRESIDENTIAL ADDRESS DELIVERED AT BLACKPOOL ON SEPTEMBER 9.

Mather, the founder of the National Park Service, bearing what is surely the most astonishing scientific expression of faith ever so inscribed :

"There will *never come an end* to the good that he has done".

We have been pleading then in turn for ethical values, for spiritual betterment, for right leisure, for moral advance, and for mental development, to co-ordinate change in man himself with every degree of advance in natural science in such a harmony that we may at last call it 'progress'. This extension of our deeper concern beyond our main concern is not really new, but it has taken a new direction. I find that exactly one hundred years ago there was a full discussion on the moral aspects, a protest that physical science was not indeed, as many alleged, taking up so much of the attention of the public as to arrest its study of the mind, of literature and the arts ; and a round declaration that by rescuing scientists from the narrowness of mind which is the consequence of limiting themselves to the details of a single science, the Association was rendering "the prevailing taste of the time more subservient to mental culture". A study of these early addresses shows that we are more diffident to-day in displaying the emotions and ideals by which I do not doubt we are all still really moved. But they also show that we are preoccupied to-day with some of the results of scientific discovery of which they were certainly then only dimly conscious. A part of that field, which ought itself to become scientific, is my theme to-day.

### Impact as the Point of Continuous Change

What do we mean by impact ? My subject is *not* the influence or effect of science upon society —too vast, varied and indeterminate for such an occasion. We may consider the position of the average man, along a line of change we call 'progress', at the beginning of a certain interval of time and at its end. We might then analyse how much is due to a change in the average man himself, his innate physical and mental powers, and how much to other influences, and particularly to science. We may debate whether the distance covered is great or small by some assumed standard, and whether progress has been rapid. We might ask whether the direction has been right, whether he is happier or better—judged again by some accepted standard. But our concern here is with none of these questions. I ask whether the transition has been difficult and distressing, in painful jerks and uprootings, costly, unwilling, or unjust ; or whether it has been easy, natural, and undisturbing. Does society make heavy weather of these changes, or does it, as the policeman would say, 'come quietly' ?

The attitude of mind of our order may be either that change is an interruption of rest and stability, or that rest and stability are a mere pause in a constant process of change. But these alternatives make all the difference to its accommodating mechanisms. In one case there will be well-developed tentacles, grappling irons, anchorages, and all the apparatus of security. In the other, society will put on casters and roller bearings, cushions, and all the aids to painless transition. The *impact* of science will be surprising and painful in one case, and smooth and undamaging in the other. Whatever may be the verdict of the past, is society and its institutions now learning that change is to be a continuous function, and that meeting it requires the development of a technique of its own ?

Science itself has usually no immediate impact upon institutions, constitutions, and philosophies of government and social relations. But its *effects* on people's numbers, location and habits soon have ; and the resistance and repugnance shown by these institutions and constitutions to the changed needs may rebound or react through those effects upon scientific enterprise itself, and make it more precarious or more difficult. Thus the effect of applications of electricity and transport improvements is clearly to make the original areal extent of city or provincial Governments quite inappropriate, and the division of functions and methods of administration archaic. If these resist change unduly, they make it more difficult and frictional, and the applications of science less profitable and less readily acceptable. Time makes ancient good uncouth. When two bodies are violent or ungainly in impact, both may be damaged. If the written constitution of the United States, devised for the 'horse and buggy' days, still proves not to be amenable to adjustment for such demands, it will be difficult to overstate the repercussion upon economic developments and the scientific enterprise that originates them. Let any Supreme Court decision of unconstitutionality on the Tennessee Valley experiment in large-scale applied science to natural problems on a co-ordinated plan bear witness. Such unnecessary resistance may be responsible for much of what has been aptly called 'the frustration of science'.

Avoidable friction in the reception given to scientific discovery not only deprives the community of advantages it might otherwise have enjoyed much earlier, or creates a heavy balance of cost on their adoption ; it may also discourage applied science itself, making it a less attractive and worthwhile pursuit. In that sense we are

considering also the impact of society upon science. This, too, is not new. The Association had as one of its first objects "to obtain a more general attention to the objects of Science, and a removal of any disadvantages of a public kind which impede its progress". The first address ever offered affirmed that the most effectual method of promoting science was the removal of the obstacles opposing its progress, and the president instanced the very serious obstacles in the science of optics due to the regulations relating to the manufacture of glass. To-day, perhaps the scientist places more stress upon the failure of Governments to encourage than upon their tendency to discourage. So much then for the *idea* of impact. Is the scientist or inventor responsible for impact, and if not, who is ?

### The Question of Responsibility

Elsewhere I have retouched Jeremy Bentham's poignant picture of the inventor of over a century ago, plans and cap in hand, on the doorstep of the rich or influential, waiting for someone to believe in him. From this type of external 'sport' amongst engineers and scientists came much or most industrial innovation, external to the processes of business. To-day, in the older and applied sciences affecting industry, the solo scientist is the exception and, with the large research departments of particular businesses and trade research associations, the picture is quite different—the expenditure higher, but the results much more rapid and numerous, even if for a time they may be kept secret. Although records of finished work may be available over the civilized world, there is much overlapping of current work, but the price of this as a whole is a far smaller fraction of the total result, if we omit from our consideration the first-magnitude discoveries of epoch-making influence. The industrial community is now far more amenable than hitherto to scientific influence ; indeed it is often the instigator in the mass of minor advances.

The new epoch of concerted industrial research dates really from the end of the Great War. During all that time I have held some middle position of responsibility between the research laboratories and institutes on one hand, and the costing and profit and loss accounts on the other, and my impression is that the proportion of work in which the initiation comes from the business end is steadily increasing. In studies of the periods of scientific and industrial gestation respectively, I have elsewhere defined *scientific gestation* as the time elapsing between the first concept of the idea and its public presentation to society in a form substantially that in which it ultimately finds extensive use without important modification ; and *industrial gestation* as the period elapsing from this point to the date when in an economic or industrial sense the innovation is effective. Both periods are difficult to determine exactly in practice, but on a broad view, the period of industrial gestation, with which alone I am here concerned, appears to me certainly to have shortened materially, though possibly at greater social cost. It would obviously be so if industry is actively encouraging research. "Faraday's discoveries came at the beginning of the great steam era, and for fifty years there would have been no difference in transport, even if those discoveries had not been made", for the telegraph was the only material influence upon it, and practical lighting was delayed until 1900.

In nearly every scientific field there is subdivision of labour, and it is rare that the worker who digs out new truth 'at the face', so to speak, is also responsible for bringing it to the surface for the public use, still less for distributing the new scientific apparatus or ideas broadly, and even less for the profitable exploitation of the whole process. These functions are nearly always distinct, even though they are embraced under one general popular description : chemist, engineer, etc. But in few cases is it any part of the professional training in the subject itself, to study how new products or processes affect the structure or welfare of society. I have questioned many scientific workers, and find them, of course, keenly alive to the positive and direct beneficial effects of their work, but they have rarely any quantitative ideas as to negative, indirect and disturbing consequences.

All these discoveries, these scientific infants, duly born and left on the doorstep of society, get taken in and variously cared for, but on no known principle, and with no directions from the progenitors. Nor do the economists usually acknowledge any duty to study this phase, to indicate any series of tests of their value to society, or even of methods and regulation of the optimum rate of introduction of novelty. These things just 'happen' generally under the urge of profit, and of consumers' desire, in free competition, regardless of the worthiness of new desires against old, or of the shifts of production and, therefore, employment, with their social consequences. The economist rightly studies these when they happen, but he is not dogmatic about them not being allowed to happen at all in just that way on account of the social disturbance or degradation of non-economic values which they may involve. It is truly a 'no-man's-land', for it is rarely that the functions of government begin until a vested problem exists. Especially in Britain we do not anticipate—"Don't worry,—it may never happen".

Problems with us are usually called 'academic' until we are 'going down for the third time'. It is a maxim of political expediency not to look too far ahead, for it is declared that one will always provide for the wrong contingency. The national foresight over wireless was exceptional, and it has to be contrasted with the opportunist treatment of the internal combustion engine. In reply, it can, of course, be urged that no one can foresee just how a scientific idea will develop until it is tried out, rough and tumble, in economic society, and to make anticipatory rules may even hinder its development.

### The Scientific Worker in the Wider Field

It is rightly stated that the training of the scientist includes no awareness of the social consequences of his work, and the training of the statesman and administrator no preparation for the potentiality of rapid scientific advance and drastic adjustment due to it, no prevision of the technical forces which are shaping the society in which he lives. The crucial impact is nobody's business.

When the research worker lifts his attention from his immediate pursuit and contemplates its hinterland, he has three possible areas of thought. He may dwell upon its practical applications and seek to make them as immediate and realistic as possible; moved by the desire not to be merely academic, he may return to his task, to focus his attention primarily on what is likely to be of practical utility, rather than on what is intellectually intriguing. Or he may think of its ultimate social consequences, and speculate on the shifts in demand, the unemployment, the loss of capital, the ultimate raising of the standard of life that may result—in other words, he may engage in economic prevision and social and political planning for the results of his efforts. Or, in the third place, he may listen and watch for hints from other fields of scientific study which may react upon his own, and suggest or solve his problems. I do not attempt to give these priority. Economic and political prevision is the most difficult and precarious, because it needs a technique different from his own, and is not given by the light of Nature.

Specialist scientists have no particular gifts for understanding the institutional processes of social life, and the psychology of multiple and mass decisions. It is a tortuous and baffling art to transmute their exact findings into the wills and lives of unscientific millions. But quite a number engage in the pursuit, and have not much greater aptitude as amateur ministers of foresight than statesmen would have in planning research. Fewer are skilled, however, in what should be the most appropriate auxiliary to their work—the synthesizing of scientific knowledge. The more penetrating they are in their main pursuits, the less may they absorb through analogy or plain intimation from outside. We constantly hear that the average clinical application lags much farther behind the new resources of diagnosis from the laboratory than circumstances compel. But it may be the other way round. The strongest hint of the presence of a particular factor—a positive element in beriberi—was given by the clinician to the biochemist, who relied entirely on the *absence* of a particular factor, a negative element, no less than fifteen years before the biochemist took serious notice, looked for it, and found it. Bacteriology and chemistry await the advance of the biochemist before they come effectively to each other's assistance. The cause and prevention of the obstinate degree of maternal mortality are objects pursued *ad hoc*, with scarcely a casual glance at the direct appeal of the eugenist to observe the natural consequences of an improvement in female infant mortality two decades earlier.

I do not then pretend to dogmatize as to how far the scientist should become a social reformer. One physicist welcomes the growing sense of social responsibility, among some scientists at least, for the world the labours of their order have so largely created, though he deplores that in this field they are still utterly unscientific. Then another great authority, Sir Henry Dale, declares that it is the scientists' job to develop their science without consideration of the social uses to which their work might be put.

I have long watched the processes by which the scientific specialist 'makes up his mind' in fields of inquiry outside his own. It seems still a matter for investigation whether the development of a specialist's thinking, on balance, impairs or improves the powers of general thinking compared with what they might otherwise have been. We do not know the kind or degree of truth that may rest in Anatole France's aphorism: "The worst of science is, it stops you thinking". Perhaps this was more subtly expressed in the simpler words of the darkie mother: "If you haven't an education, you've jest *got* to use yoh brains".

My own experience is that when the attempt to deal with social consequences is made, we quickly find ourselves either in the field of larger politics debating the merits of the three prevalent forms of State government, or else performing miracles with fancy currencies and their blue prints reminiscent of the chemical engineer.

### Human Aspects of Changing Industry

There are, however, some essential features of the impact which must be dealt with under any form of society and government, and with any machinery for regulating values. They involve man's abilities, his affections, and his tools, all of which have been brusquely treated in the past, and might be scientifically treated in the future. An industrial civilization is unthinkable without division, and, therefore, specialization, of labour, and without tools and capital instruments. Then life itself is not much worth living without social ties and the allegiances of place and kin. These three indispensable elements of the good life bring out defensive mechanisms for their protection. No one likes to see a man, highly trained for a special service or specially fitted by natural aptitudes, cut off from opportunity to use his powers and reduced to the level of an unskilled biped. No one likes to see the results of abstinence and specially directed labour which is embodied in a great machine or factory rendered impotent long before it has given its life's usefulness. Waste of skill and of capital are alike grave faults by which we should judge and condemn an industrial organization. Since man does not live by bread alone, if a ruthless industrial organization continually tears up the family from its roots, transferring it without choice to new surroundings, destroying the ties of kin, home and social life, of educational and recreational environments, it is far from ideal. Human labour can never be indefinitely fluid and transferable in a society that has a soul above consumption of mere commodities.

These three obstructions to change are not final and rigid limitations upon it. Men die, their skill and home associations with them. Plant and equipment wear out. Their successor presents a natural opportunity in each of the three cases for the introduction of change in position, in aptitude, in purpose or design, without waste or human distress. The length of working life and the durability of materials mark the natural phase or periodicity of a smoothly changing society —its quanta, so to speak. But the impetus for change or the irritant has no such intervals. It proceeds from various causes: varying harvests, changes in natural forces; changing human desires and fashions; differences in the rate of growth of population in its different parts; the collective psychological errors of optimism and pessimism in business in an individualistic society; variations in gold supplies and credit policies based thereon. All or any of these, without invoking any disturbances from the impact of scientific discovery, would serve to make adjustments necessary outside the natural phases to which I have referred, in a society with parts that are interdependent through division of labour, and localization of industry, joined by foreign trade and convenient transport. These alone would bring about a changing world with incomplete adaptations, loss of capital, and so-called frictional unemployment.

It is easy to exaggerate the adjustment necessary for the addition of invention and science to these causes of change. But with the intensification of scientific effort, and the greater sub-division of industry, the possible dislocation becomes more frequent, and the ways of meeting such change of greater public importance. This field of inquiry includes widely diverse questions, for example, patent laws, invention clearing, obsolescence accountancy and costing regulation, taxation adjustments, local rating pooling, trade union regulations, price controls, technical education, age and other discriminations in unemployment relief, transfer bonuses, pension rights, housing facilities, and more selective direction of financial support of intensive scientific research. In this neutral field the specialist scientist and the politician are both amateurs. It is to be covered by each extending his studies, and by specialists who treat impact and change as an area of scientific study.

I do not propose to go over all the ground, so old, so constantly renewed, as to the effect of machinery upon employment. It is known as a historical induction that, in the long run, it makes more employment than it destroys, in providing work in making the machinery, in reducing price so that far greater quantities of the commodity concerned may be consumed, and in enabling purchasing power to be diverted to increase other productions. It has even facilitated the creation of a larger population, which in turn has provided the new markets to work off the additional potentiality of the machinery. It does all this in 'the long run'; but man has to live in the 'short run', and at any given moment there may be such an aggregation of unadjusted 'short runs' as to amount to a real social hardship. Moreover, it comes in this generation to a people made self-conscious by statistical data, repeated widespread at frequent intervals, and to a people socially much more sensitive to all individual hardship and vicissitude which is brought about by communal advance.

### The 'Balance of Innovation' and Population

There are two important aspects of the change induced by science which are insufficiently realized, and which make a profound difference to the direction of thought and inquiry. The first I will call the 'balance of innovation' and the second the 'safety valve' of population.

The changes brought by science in economic life may be broadly classified as the 'work creators' and the 'work savers'. The latter save time, work and money by enabling the existing supply of particular commodities to be produced more easily, and therefore at lower cost, and finally at lower prices. People can spend as much money as before upon them and get larger quantities, or they can continue to buy their existing requirements at a lower cost. In this second event they 'save money' and their purchasing power is released for other purposes. By a parallel process, producing or labouring power is released through unemployment. The released working force and released purchasing power can come together again in an *increased* demand for other products which, to this extent, have not been hitherto within effective demand. The supply of this increase may go part or all of the way to absorb the displaced labour. But this process takes time, and the labour displaced is not at once of the right kind or in the right place. More important, however, is the invention of quite new objects of public demand, which may be desired in addition to the supply of old ones. This brings together released labour and released purchasing power in the most decisive way.

The most orderly and least disturbing phases of progress will be found when these two types of innovation are reasonably balanced. Of course, few new objects of purchasing ambition are entirely additive; most of them displace some other existing supplies. Artificial silk displaces some cotton consumption, radio may displace some types of musical instruments. Recently the German production of pianos and guitars has been at a very low percentage of capacity, and part of this has been made good by the demand for radio sets. The dislocations caused by labour-saving machinery can most easily be made good by a due *balance* of new labour-creating commodities.

A natural increase of population is the best shock absorber that the community can possess, especially if accompanied by an extension of territory such as the United States enjoyed in the constant westward movement of the frontier in the nineteenth century, or Britain in the period of overseas emigration. A moment's reflection will show why this is the case. Assume that 1,000,000 units of a commodity are made by 100,000 men, and that there is an increase of population of 2 per cent per annum, so that in five years 1,100,000 units will be consumed and employ 110,000 men. Now assume the introduction of a new invention which enables 1,100,000 units to be made by 100,000 men. There will be no displacement of existing labour, but only a redirection of new and potential labour from that industry to other fields. Again, a considerable reduction in demand *per head* can be sustained without dislocation, if the actual aggregate of production demanded is maintained by increasing numbers. The affected industry can remain static and need not become derelict. New entrants to industry will be directed to those points where purchasing power, released through labour-saving devices, is creating new opportunity with new products. New capital is also naturally directed into the new channels, instead of into additions to the old industry.

Now the problem before all Western industrial countries is the fact that their populations are shortly becoming stationary (and then will begin to decline noticeably) and this safety valve of increasing population will no longer be available. Every transfer of *per capita* purchasing power to new directions must then be a definite deduction from the old directions, no longer made good by the steady increase in the numbers demanding less per head from those old sources. The impact of science upon a stationary population is likely, *ceteris paribus*, to be much more severely felt than upon a growing population, because the changes of direction cannot be absorbed by the newly directed workers. Of course, the effects of a static population can be mitigated if the *per capita* income is increasing, because a new direction of demand can be satisfied out of the additional purchasing power without disturbing the original directions of demand provided by the original purchasing power.

The change from a growing to a static or declining population is only one type of difficulty. While the aggregate is altering but slowly, the parts may be changing rapidly. Thus, in Great Britain, 40·4 millions in 1937 becomes 40·6 in 1942, 40 in 1947, 39·8 millions in 1952, 38·9 in 1957 and 37·5 in 1962. But the children aged sixteen years—which I take because of its influence on schools, teaching and industrial entry—have been estimated, taking those in 1937 as 100, to be 85 in 1942, 73 in 1952 and 62 in 1962. A fall of this magnitude means that industries and institutions dependent upon the present numbers must not be merely static but actually regressive. On the other hand, the old people from sixty-five to seventy-four years will increase in this ratio—100, 113, 127, and 133. These problems of static populations at home are accentuated by the possibility of a similar tendency abroad, and need thought in advance. The Australian farmer is more affected by the British conditions of population than by his own.

We have thus the first difficulty, that of a static total demand, the second, that the safety valve of new industrial entrants is becoming smaller,

but a third difficulty comes from the present tendency of that class. A stationary elderly population must be very inflexible to change, but a stream of new young life, even if it is to be smaller, would give the opportunity for just that change of direction, in training and mobility, which society needs. But unfortunately, in practice this does not now seem to be very adaptable. For we learn from certain Unemployment Insurance areas that while the older people will willingly take jobs at wages a few shillings in excess of the unemployment relief, the younger men are more difficult. For every one that will accept training under good conditions to suit them for eligible work, ten may refuse, and the number who will not go any distance to take work at good wages is also in excess of those who do. Attachment to place for older people is understandable, and has been accentuated by housing difficulties—one learns of miners unemployed in a village where the prospects of the pit reopening are negligible, while at the same time, only twenty miles away, new miners are being created by attraction from agriculture to more extended workings in their area. The very social machinery which is set up to facilitate change or to soften dislocation aggravates the evil. The first two difficulties are unalterable. This third difficulty is a subject for scientific examination.

### Industrial Disequilibrium

So much for the effect of change of any kind upon employment. Now let us narrow this to scientific changes. At any given moment the impact of science is always causing some unemployment, but at that same time the constructive additional employment following upon past expired impacts is being enjoyed. But it is easy to exaggerate the amount of the balance of net technological unemployment. For industrial disequilibrium arises in many ways, having nothing whatever to do with science. Changes of fashion, exhaustion of resources, differential growth in population, changing customs and tariffs, the psychological booms and depressions of trade through monetary and other causes, all disturb equilibrium, and, therefore, contract and expand employment in particular places.

Our analytical knowledge of unemployment is bringing home the fact that, like capital accumulation, it is the result of many forces. A recent official report indicated that a quite unexpected amount or percentage of unemployment would be present even in boom times. We know already that there may be a shortage of required labour in a district where there is an 8 or 10 per cent figure of unemployment. So, in Great Britain there may well be a million unemployed in what we should call good times—it is part of the price we pay for the high standard of life secured by those who retain employment. For a level of real wage may be high enough to prevent every one being employable at that wage—though that is by no means the whole economic story of unemployment. Of this number, probably 200,000 would be practically unemployable on any ordinary basis—the 'hard core' as it is called. Perhaps seven or eight hundred thousand form the perpetual body, changing incessantly as to its unit composition, and consisting of workers undergoing transition from job to job, from place to place, from industry to industry, with seasonal occupations—the elements of 'frictional' unemployment through different causes. Out of this number, I should hazard that not more than 250,000 would be unemployed through the particular disturbing element of net scientific innovation.

This is the maximum charge that should be laid at the door of science, except in special times, such as after a war, when the ordinary application of new scientific ideas day by day has been delayed, and all the postponed changes tend to come with a rush. At any given moment, of course, the technological unemployment that could be computed from the potentiality of new processes over displaced ones appears to be much greater. But such figures are *gross*, and from them must be deducted all recent employment in producing new things or larger production of old things, due to science. If we are presenting science with part of the responsible account of frictional unemployment at any moment, it will be the total technological reduction due to new processes and displacement due to altered directions of demand, less the total new employment created by new objects of demand. This has to be remembered when we are being frightened by the new machine that does with one man what formerly engaged ten. Perhaps birth control for people demands ultimately birth control for their impedimenta.

The rate of introduction of new methods and the consequent impact upon employment may depend upon the size and character of the business unit. If all the producing plants for a particular market were under one control, or under a co-ordinated arrangement, the rate of introduction of a new labour-saving device will be governed by a simple consideration. It can be introduced with each renewal programme for each replacement of an obsolete unit, and therefore without waste of capital through premature obsolescence. But this applies only to small advantages. If the advantages are large, the difference in working costs for a given production between the old and the new types may be so considerable that it will meet not only all charges for the new capital, but

also amortize the wasted life of the assets displaced before they are worn out. In neither case then is there any waste of capital, and the absorption of the new idea is orderly in time. But it is quite otherwise if the units are in different ownerships. Excess capacity can quickly result from new ideas. A new ship or hotel or vehicle with the latest attractions of scientific invention, quite marginal in their character, may obtain the bulk of the custom, and render half empty and, therefore, half obsolete, a unit built only a year before. The old unit has to compete by lower prices, and make smaller profits. The newer unit is called upon to bear no burdens in aid of the reduced capital values of the old. It may be that the enhanced profits of the one added to the reduced profits of the other make an average return upon capital not far different from the average that would result in a community where orderly introduction on a renewal basis is the rule. Or perhaps the community gets some of its novelties rather earlier under competitive conditions, and pays a higher rate of interest for them as a net cover for the risks of obsolescence. Waste of capital would be at a minimum if the 'physical' life before wearing out were as short as the 'social' life of the machine. To make a thing so well that it will last 'for ever' is nothing to boast about if it will be out of fashion in a few years.

Scientists often look at the problem of practical application as if getting it as rapidly as possible were the only factor to be considered in social advantage, and this difference in the position of monopoly or single management in their ability to 'hold up' new ideas is treated as a frustration in itself. Thus it has been said "the danger of obsolescence is a great preventative of fundamental applications to science. Large firms tend to be excessively rigid in the structures of production". Supposing that the obsolescence in question is a real factor of cost, it would fall to be reckoned with in the computation for transition, whatever the form of society, and even if the personal 'profit' incentive were inoperative. It cannot be spirited away. A customary or compulsory loading of costs for short-life obsolescence would retard uneconomically rapid competition of novelties and could be scientifically explored.

### The Charge for Displaced Labour

Now let us look at displaced labour and the costs of it. If the effect of diversion of demand through invention is to reduce the scope or output of particular industries or concerns in private management, they have no option but to reduce staff. If the pressure is not too great, or the change too rapid, this does not necessarily result in dismissals, for the contraction of numbers may be made by not filling up, with young people, the vacancies caused by natural wastage, through death and retirement. But where dismissals are inevitable, re-engagements may take place quickly in the competing industries, otherwise unemployment ensues. Any resulting burden does not fall upon the contracting and unprofitable industry —it has troubles enough of its own already. Nor is it put upon the new and rising industry, which is attracting to itself the transferred profits. In the abstract, it might be deemed proper that before the net gains of such an industry are computed or enjoyed it should bear the burdens of the social dislocation it causes by its intrusion into society. In practice, it would be difficult to assess its liability under this head, and in fact even if it could be determined, new industries have so many pioneer efforts and losses, so many failures, so many superseded beginnings, that it might well be bad social policy to put this burden upon them, for they would be discouraged from starting at all, if they had to face the prospect of such an overhead cost whatever their results.

It would, of course, be theoretically possible to put a special levy on those new industries that turned out to be profitable, and to use it to relieve the social charges of dislocation of labour. But much the same argument could be used for the relief of obsoletism of capital. The distinction would, however, be that in the case of the capital it could be urged that the investor should have been wide enough awake to see the possibilities of the rival, whereas the worker, induced to take up employment in such a superseded industry, was a victim, and could not be expected to avoid it by prevision. In any event, the prevailing sentiment is rather to encourage developing industries, than to put special burdens upon them, in order that the fruits of science may be effectively enjoyed by society with as little delay as possible.

In the upshot, therefore, the injuries to labour, though not to capital, are regarded as equitably a charge to be borne by society in general through taxation, and to be put upon neither the causing nor the suffering business unit.

It may well be assumed that, taken throughout, the gains of society as a whole from the rapid advance are ample enough to cover a charge for consequential damages. But society is not consciously doing anything to regulate the rate of change to an optimum point in the net balance between gain and damage.

The willingness of society to accept this burden is probably mainly due to the difficulty of fairly placing it, for we find that when it *can* actually be isolated and the community happens fortuitously to have a control, or the workers a power to induce,

it will be thrown, not upon the attacking industry, if I may so call it, but upon the defender. Thus in the United States recently, the price of consent to co-ordinating schemes made for the railroads to reduce operating expenses has been an agreement on this very point. If staff is dismissed, as it was on a large scale in the depression, because of fewer operations and less stock in consequence of reduced carriage through the smaller volume of trade, or through road and sea competition, no attempt was made to put any of the social cost upon the railroads, and the dismissed staff become part of the general unemployed. But if the self-defence of the companies against competition takes the form of co-operation with each other to reduce operations and stock and, therefore, costs, any resultant dismissals are made a first charge upon them.

The agreement is elaborate, and has the effect of preventing any adjustments which an ordinary business might readily make when it throws the burden on society, unless those adjustments yield a margin of advantage large enough to pay for their particular special effects. Thus the rapidity of adjustment to new conditions, not to meet the case of higher profits to be made at the expense of workers, but rather to obviate losses through new competition, is materially affected, and a brake is put upon the mechanism of equilibrium in this industry which does not exist in its rivals, or in any others where the power exists to throw it upon the community. A similar provision exists in the Argentine, and it is imposed by Act of Parliament in Canada, but as one of the concerns is nationally owned, and the current losses fall upon the national budget, its charge is really socially borne in the end.

In Great Britain such provisions were part of the amalgamation project of 1923, and of the formation of a single transport authority in London in 1933, and, therefore, did not arise through steps taken to meet new factors of competition. But the opportunity for their imposition came when rights to road powers and rights to pooling arrangements were sought by the railways —both of them adjusting mechanisms to minimize the losses due to the impact of new invention— and this was clearly a specialized case of keeping the burdens off society. In the case of the electricity supply amalgamation of 1933, brought about for positive advantages rather than in defence against competition, similar provision was made, and parliamentary powers for transfers to gas and water undertakings, also not defensive against innovation, have been accompanied by this obligation. In the case of such uncontrolled businesses as Imperial Chemicals and Shell Mex, rationalizing to secure greater profits, rather than fighting rearguard actions to prevent losses, obligations to deal with redundancies have been voluntarily assumed. In such cases the public obloquy of big business operations inimical to society can be a negative inducement, but some freedom from radical competition in prices provides a positive power to assume the burden initially, and pass it forward through price to consumers, rather than back against shareholders. The third case, however, of making it a net charge on the improved profits, is quite an adequate outlet. If the principle of putting this particular obstacle in the way of adjustments to meet new competition (as distinct from increasing profits) is socially and ethically correct, it is doubtful whether it is wisely confined to cases where there is quite fortuitously a strategic control by public will.

It will be clear that the difference between the introduction by purely competitive elements involving premature obsolescence and unemployment, and by delayed action, is a cost to society for a greater promptness of accessibility to novelty. The two elements of capital and labour put out of action would have supplied society with an extra quantity of existing classes of goods, but society prefers to forgo that for the privilege of an earlier anticipation of new things. I estimate this price to be of the order of 3 per cent of the annual national income. But when we speak of social advantage, on balance, outweighing social cost, we dare not be so simple in practice. If the aggregate individual advantage of adopting some novelty is $100x$ and the social cost in sustaining the consequential unemployed is $90x$, it does not follow that it is a justifiable bargain for society. The money cost is based on an economic minimum for important reasons of social repercussions. But the moral effects of unemployment upon the character and happiness of the individual escape this equation altogether, and are so great that we must pause upon the figures. What shall it profit a civilization if it gain the whole world of innovation and its victims lose their souls ?

So far I have treated the problem of innovation as one of uneconomic rapidity. But there is another side—that of improvident tardiness. Enormous potentialities are seen by scientists waiting for adoption for human benefit, under a form of society quicker to realize their advantage, readier to raise the capital required, readier to pay any price for dislocation, and to adjust the framework of society accordingly. A formidable list of these potentialities can be prepared, and there is little doubt that with a mentality adjusted for change, society could advance much more rapidly. But there is a real distinction between the methods of adopting whatever it is decided to adopt, and the larger question of a more thoroughgoing adoption.

In proportion as we can improve the impact of the present amount of innovation, we can face the problem of a larger amount or faster rate. Unless most scientific discoveries happen to come within the scope of the profit motive, and it is worth someone's while to supply them to the community, or unless the community can be made sufficiently scientifically minded to include this particular demand among their general commercial demands, or in substitution for others, nothing happens—the potential never becomes actual. It has been computed that a benevolent dictator could at a relatively small expense, by applying our modern knowledge of diet, add some two inches to the average stature, and seven or eight pounds to the average weight of the general population, besides enormously increasing their resistance to disease. But dictators have disadvantages, and most people prefer to govern their own lives indifferently, rather than to be ideal mammals under orders. To raise their own standard of scientific appreciation of facts is the better course, if it is not Utopian. It has been clear for long enough that a diversion of part of the average family budget expenditure from alcohol to milk would be of great advantage. But it has not happened. If the individual realized the fact, it certainly might happen. It is ironically remarked that the giving of free milk to necessitous children, with all the net social gain that it may bring about, has not been a considered social action for its own sake, but only the by-product emergency of commercial pressure—not done at the instance of the Ministry of Health or the Board of Education, but to please the Milk Marketing Board by reducing the surplus stocks of milk in the interests of the producer!

## Planning and its Limitations

Scientists see very clearly how, if politicians were more intelligent, if business men were more disinterested, and had more social responsibility, if Governments were more fearless, far-sighted, and flexible, our knowledge could be more fully and quickly used to the great advantage of the standard of life and health—the long lag could be avoided, and we should work for social ends. It means, says Dr. Julian Huxley, "the replacement of the present socially irresponsible financial control by socially responsible planning bodies". Also, it obviously involves very considerable alterations in the structure and objectives of society, and in the occupations and pre-occupations of its individuals.

Now a careful study of the literature of planning shows that it deals mainly with planning the known, and scarcely at all with planning for changes in the known. Although it contemplates 'planned' research, it does not generally provide for introducing the results of new research into the plan, and for dealing with the actual *impact*—the unemployment, redirection of skill, and location, and the breaking of sentimental ties that distinguish men from robots. It seems to have not many more expedients for this human problem than our quasi-individualist society with its alleged irresponsibility. It also tends to assume that we can tell in advance what will succeed in public demand and what will be superseded. There is nothing more difficult, and the attempt to judge correctly under the intellectual stimulus of high profits and risk of great losses is at least as likely to succeed as the less personally vital decision on a committee. Would a planning committee, for example, planning a new hotel in 1904, have known any better than capitalist prevision that the fifteen bathrooms then considered adequate for social demand ought really to have been ten times that number if the hotel was not to be considered obsolete thirty years later? Prevision thought of in terms of hindsight is easy, and few scientists have enjoyed the responsibility of making practical decisions as to what the public will want far ahead. They, therefore, tend to think of prevision in terms of knowledge and appreciation of particular scientific possibilities, whereas it involves unknown demand schedules, the unceasing baffling principle of substitution, the inertia of institutions, the crusts of tradition and the queer incalculability of mass mind. Of course, in a world where people go where they are told, when they are told, do what they are instructed to do, accept the reward they are allotted, consume what is provided for them, and what is manifestly so scientifically 'good for them', these difficulties need not arise. The human problem will then be the 'impact of planning'.

I am not here examining the economics of planning as such, but only indicating that it does not provide automatically the secret of correct prevision in scientific innovation. When correct prevision is possible, a committee can aim at planning with a minimum disturbance and wastage (and has the advantage over individuals acting competitively), but for such innovation as proves to be necessary it does not obviate the human disturbance or radically change its character. The parts of human life are co-ordinated and some are more capable of quick alteration than others, while all are mutually involved. One may consider the analogy of a railway system which has evolved, partly empirically and partly consciously, as a co-ordinated whole. Suddenly the customary speed is radically changed, and then it may be that all the factors are inappropriate—distance between

signals, braking power, radius of curves, camber or super-elevation, angles of crossings, bridge stresses. The harmony has been destroyed. Especially may this be the case if the new factor applies to some units only, and not to all, when the potential density of traffic may be actually lessened. The analogy for the social system is obvious, and its form of government matters little for the presence of the problem, though it may be important in the handling of it.

I have spoken as though the normal span of life of men and machinery themselves provides a phase to which scientific advance might be adjusted for a completely smooth social advance. But this would be to ignore customs and institutions, even as we see in Federal America, Australia and Canada, constitutions which lengthen that phase and make it less amenable as a natural transition. At one time we relied on these to bring about the economic adjustment necessary. But technical changes take place so rapidly that such forces work far too slowly to make the required adaptation. Habits and customs are too resistant to change in most national societies to bring about radical institutional changes with rapidity, and we patch with new institutions and rules to alleviate the effects rather than remove the causes of maladjustments. The twenty mile speed limit long outstayed its fitness, and old building restrictions remained to hamper progress. Edison is reported to have said that it takes twenty-five years to get an idea into the American mind. The Webbs have given me a modal period of nineteen years from the time when an idea comes up as a practical proposition from a 'dangerous' left wing to the date when it is effectively enacted by the moderate or 'safe' progressive party. This period of political gestation may be a function of human psychology or of social structure. We do not know how ideas from a point of entry permeate, infiltrate or saturate society, following the analogues of conduction, convection, or lines of magnetic force.

Our attitude of mind is still to regard change as the exceptional, and rest as the normal. This comes from centuries of tradition and experience, which have given us a tradition that each generation will substantially live amid the conditions governing the lives of its fathers, and transmit those conditions to the succeeding generation. As Whitehead says: "we are living in the first period of human history for which this assumption is false". As the time span of important change was considerably longer than that of a single human life, we enjoyed the illusion of fixed conditions. Now the time span is much shorter, and we must learn to experience change ourselves.

## Cultural Lags in a Dynamic Society

I have so far discussed modification of impact to meet the nature of man. Now we must consider modifying the nature of man to meet impact.

Sociologists refer to our 'cultural lags' when some of the phases of our social life change more quickly than others and thus get out of gear and cause maladjustments. Not sufficient harm is done to strike the imagination when the change is a slow one, and all the contexts of law, ethics, economic relations and educational ideals tend towards harmony and co-ordination. We can even tolerate, by our conventions, gaps between them, while preachers and publicists can derive certain amusement and profit from pointing out our inconsistencies. But when things are moving very rapidly, these lags become important; the concepts of theology and ethics, the tradition of the law, all tend to lag seriously behind changes brought about through science, technical affairs and general economic life. Some hold that part of our present derangement is due to the lack of harmony between these different phases—the law and governmental forms constitutionally clearly lag behind even economic developments as impulsed by scientific discovery. An acute American observer has said that "the causes of the greatest economic evils of to-day are to be found in the recent great multiplication of interferences by Government with the functioning of the markets, under the influence of antiquated doctrines growing out of conditions of far more primitive economic life". It would be, perhaps, truer to say that we are becoming 'stability conscious', and setting greater store, on humanitarian grounds, by the evil effects of instability.

In the United States it would be difficult to find, except theoretically in the President, any actual person, or instrument in the constitution, having any responsibility for looking at the picture of the country as a whole, and there is certainly none for making a co-ordinated plan. Indeed, in democracy, it is difficult to conceive it, because the man in public life is under continual pressure of particular groups, and so long as he has his electoral position to consider, he cannot put the general picture of progress in the forefront. Whitehead declared that when an adequate routine, the aim of every social system, is established, intelligence vanishes and the system is maintained by a co-ordination of conditioned reflexes. Specialized training alone is necessary. No one, from President to miner, need understand the system as a whole.

The price of pace is peace. Man must move by stages in which he enjoys for a space a settled idea, and thus there must always be something which is

rather delayed in its introduction, and the source of sectional scientific scorn. If every day is 'moving day', man must live in a constant muddle, and create that very fidget and unrest of mind which is the negation of happiness; always 'jam to-morrow'—the to-morrow that 'never comes'. If we must have quanta or stages, the question is their optimum length and character, not merely the regulation of industry and innovation to their tempo, but also the education of man and society to pulse in the same rhythmic wave-length or its harmonic.

### The Balance of Physical and Biological Sciences

In some ways we are so obsessed with the delight and advantage of discovery of new things that we have no proportionate regard for the problems of arrangement and absorption of the things discovered. We are like a contractor who has too many men bringing materials on to the site, and not enough men to erect the buildings with them. In other words, if a wise central direction were properly allocating research workers to the greatest marginal advantage, it would make some important transfers. There is not too much being devoted to research in physics and chemistry, as modifying industry; but there is too much relatively to the research upon the things they affect, in physiology, psychology, economics, sociology. We have not begun to secure an optimum balance. Additional financial resources should be applied more to the biological and human sciences than to the applied physical sciences, or possibly, if resources are limited, a transfer ought to be made from one to the other.

Apart from the superior tone sometimes adopted by 'pure science' towards its own applications, scientific snobbery extends to poor relations. Many of the hard-boiled experimental scientists in the older and so productive fields look askance at the newer borderline sciences of genetics, eugenics and human heredity, psychology, education, and sociology, the terrain of so much serious work but also the happy hunting ground of 'viewey' cranks and faddists. Here the academic soloist is still essential, and he has no great context of concerted work into which to fit his own. But unless progress is made in these fields which is comparable with the golden ages of discovery in physics and chemistry, we are producing progressively more problems for society than we are solving. A committee of population experts has recently found that the expenditure on the natural sciences is some eight to ten times greater than that on social sciences. There is scarcely any money at all available for their programme of research into the immense and vital problems of population in all its qualitative and quantitative bearings. An attack all along the front from politics and education to genetics and human heredity is long overdue. Leisure itself is an almost unexplored field scientifically. For we cannot depend wholly on a hit and miss process of personal adaptation, great though this may be.

There must be optimal lines of change which are scientifically determinable. We have seen in a few years that the human or social temperament has a much wider range of tolerance than we had supposed. We can take several popular examples. The reaction to altered speed is prominent. In the "Creevey Papers", it is recorded that the Knowsley party accomplished 23 miles per hour on the railway, and recorded it as "frightful—impossible to divest yourself of the notion of instant death—it gave me a headache which has not left me yet—some damnable thing must come of it. I am glad to have seen this miracle, but quite satisfied with my first achievement being my last". At the British Association meeting of 1836, an address on railway speeds prophesied that some day 50 miles an hour might be possible. Forty years ago we may remember that a cyclist doing 15–18 miles an hour was a 'scorcher' and a public danger. Twenty-five years ago, 30 miles an hour in motoring was an almost unhealthy and scarcely bearable pace. To-day the fifties and sixties are easily borne, both by passenger and looker-on. Aeroplane speeds are differently judged, but at any rate represent an extension of the tolerance. Direct taxation thirty years ago in relation to its effect on individual effort and action seemed to reach a breaking-point and was regarded as psychologically unbearable at levels which to-day are merely amusing. The copious protection of women's dress then would have looked upon to-day's rationality as suicidal lunacy.

One hesitates to say, therefore, that resistances to scientific changes will be primarily in the difficulty of mental and physical adjustments. But there can be little doubt that with the right applications of experimental psychology and adjusted education, the mind of man would be still more adaptable. Unfortunately, we do not know whether education as an acquired characteristic is in any degree inheritable, and whether increasing educability of the mass is a mere dream, so that we are committed to a Sisyphean task in each generation. Nor do we know whether this aspect is affected by the induced sterility of the age. It may not be a problem of changing the same man in his lifetime, but of making a larger difference between father and son. The latest teachings of geneticists hold out prospects for the future of

man which we should like to find within our present grasp, and recent successful experiments with mammals in parthenogenesis and eutelegenesis bear some inscrutable expression which may be either the assurance of new hope for mankind or a devil's grin of decadence.

### The New Economics

What is economics doing in this kaleidoscope? The body of doctrine which was a satisfactory analysis of society twenty-five years ago is no longer adequate, for its basic postulates are being rapidly changed. It confined itself then to the actual world it knew and did not elaborate theoretical systems on different bases which might never exist. It is, therefore, now engaged in profoundly modifying the old structures to meet these new conditions. Formerly it assumed, quite properly, a considerable degree of fluid or competitive adjustment in the response of factors of production to the stimulus or operation of price, which was really a theory of value-equilibrium. Wherever equilibrium was disturbed, the disturbance released forces tending to restore it. To-day many of the factors formerly free are relatively fixed, such as wage-levels, prices, market quotas, and when an external impact at some point strikes the organism, instead of the effect being absorbed throughout the system by adjustments of all the parts, it now finds the shock evaded or transmitted by many of them, leaving the effects to be felt most severely at the few remaining points of free movement or accommodation. Unemployment is one of these. The extent to which this fact throws a breaking strain upon those remaining free points is not completely analysed, and the new economics of imperfect competition is not fully written out or absorbed. The delicate mechanism of price adjustment with the so-called law of supply and demand governed the whole movement, but with forcible fixation of certain price elements consequences arise in unexpected and remote quarters. Moreover, the search for a communally planned system to secure freedom from maladjustments involves a new economics in which the central test of price must be superseded by a statistical mechanism and a calculus of costs which has not yet been satisfactorily worked out for a community retaining *some* freedom of individual action and choice.

The old international currency equilibrated world forces and worked its way into internal conditions in order to do so. But the modern attempt to prevent any internal effect of changes in international trade, or to counteract them, and the choice of internal price stability at all costs against variable international economic equations, has set economic science a new structure to build out of old materials. At this moment when elasticity is most wanted, stability leading to rigidity becomes a fetish. The aftermath of war is the impossibility of organizing society for peace.

The impact of economic science upon society to-day is intense and confusing, because, addressing itself to the logic of various sets of conditions as the likely or necessary ones according to its exponents' predilections, it speaks with several voices, and the public are bewildered. Unlike their claims upon physics and mathematics, since it is dealing with money, wages and employment, the things of everyday, they have a natural feeling that it ought to be easily understandable and its truth recognizable. Balfour once said, in reference to Kant, "Most people prefer a problem which they cannot explain, to an explanation which they cannot understand". But in the past twenty years, the business world and the public have become economics-conscious, and dabble daily in index numbers of all kinds, and the paraphernalia of foreign exchange and statistics of economic life. The relativity of economic principle to national psychology baffles the economists themselves, for it can be said truly at one and the same time, for example, that confidence will be best secured by balancing the Budget, and by not balancing it, according to public mentality.

The economics of a community not economically self-conscious are quite different from those of a people who watch every sign and act accordingly. Thus the common notion that economics should be judged by its ability to forecast (especially to a particular date) is quite fallacious, for the prophecy, if 'true' and believed, must destroy itself, inasmuch as the economic conduct involved in the forecast is different after the forecast from what it would have been before. The paradox is just here, for example: if a people are told that the peak of prices in a commodity will actually be on June 10, they will all so act that they anticipate the date and destroy it. Economics, thoroughly comprehended, can well foretell the effects of a tendency, but scarcely ever the precise date or amount of critical events in those effects. The necessity for a concentration upon new theoretical and analytical analysis, and upon realistic research, is very great. But so also is the need for widespread and popular teaching. For a single chemist or engineer may by his discovery affect the lives of millions who enter into it but do not understand it, whereas a conception in economic life, however brilliant, generally requires the conformity of the understanding and wills of a great number before it can be effective.

### The Science of Man

But not alone economics: if the impact of science brings certain evils, they can only be cured by more science. Ordered knowledge and principles are wanted at every point. Let us glance at three only, in widely different fields: man's work, man's health, man's moral responsibility. The initial impact of new science is in the factory itself. The kind of remedy required here is covered by the work of the National Institute of Industrial Psychology. Some of this improves upon past conditions, some creates the conditions of greater production, but much of it combats the evils arising from new conditions created by modern demands, speed, accuracy and intensity. It invokes the aid of many branches of science. It is the very first point of impact. Yet its finance is left to personal advocacy, and commands not 10 per cent of the expenditure on research in artificial silk, without which the world was reasonably happy for some centuries. We can judge of the scope of this by the reports of the Industrial Health Research Board.

Again, the scientific ancillaries of medicine have made immense strides. Clinical medicine as an art makes tardy, unscientific and halting use of them. The public remain as credulous as ever, their range of gullibility widened with every pseudo-scientific approach. (We do not know what proportion of positive cases can create the illusion of a significant majority in mass psychology, but I suspect that it is often as low as twenty per cent.) For a considerable range of troubles inadequately represented in hospitals, the real experience passes through the hands of thousands of practitioners, each with too small a sample to be statistically significant, and is, therefore, wasted from a scientific point of view. Half-verified theories run riot as medical fashions, to peter out gradually in disillusionment. If the scattered cases were all centralized through appropriately drawn case-histories, framed by a more scientifically trained profession, individual idiosyncrasy would cancel out, and mass scrutiny would bring the theories to a critical statistical issue of verification or refutation in a few months. This would be to the advantage of all society, and achieve an even greater boon in suggesting new points for central research.

A suggestion has been made for an inventions clearing house, to "co-operate the scientific, social and industrial phases of Invention, and to reduce the lag between invention and application" managed by a committee of scientists and a committee of industrialists and bankers. The proposal came to me from New York, but London was to be the home of the organization, which was to adopt a code of ethics in the interests of inventors, industry and *social progress*. This brings me to my third example, the field of ethics, which needs the toil of new thought. The systems of to-day, evolving over two thousand years, are rooted in individualism and the relations between individuals. But the relations of society to-day are not predominantly individual, for it is permeated through and through with corporate relations of every kind. Each of these works over some delegated area of the individual's choice of action, and evolves a separate code for the appropriate relationship. The assumption that ethical questions are decided by processes which engage the individual's whole ethical personality is no longer even remotely true. The joint stock company may do something, or refrain from doing something, on behalf of its shareholders, which is a limited field of ethics, and may but faintly resemble what they would individually do with all other considerations added to their financial interests. The whole body of ethics needs to be reworked in the light of modern corporate relations, from Church and company, to cadet corps and the League of Nations.

In no case need we glorify change: but true rest may be only ideally controlled motion. The modern poet says:

> "The endless cycle of idea and action,
> Endless invention, endless experiment,
> Brings knowledge of motion, but not of stillness".

But so long as we are to have change—and it seems inevitable—let us master it. T. S. Eliot goes on:

> "Where is the wisdom we have lost in knowledge ?
> Where is the knowledge we have lost in information ?"

My predecessors have spoken of the shortcomings of the active world—to me they are but the fallings short of science. Wherever we look we discover that if we are to avoid trouble we must take trouble—scientific trouble. The duality which puts science and man's other activity in contrasted categories with disharmony to be resolved, gaps to be bridged, is unreal. We are simply beholding ever-extending science too rough round the edges as it grows.

What we have learnt concerning the proper impact of science upon society in the past century is trifling, compared with what we have yet to discover and apply. We have spent much and long upon the science of matter, and the greater our success the greater must be our failure, unless we turn also at long last to an equal advance in the science of man.

# Summaries of Addresses of Presidents of Sections*

## Trends in Modern Physics

IN his presidential address to Section A (Mathematical and Physical Sciences), Prof. Allan Ferguson, after referring to the heavy loss which physical science has suffered in the deaths of Sir John McLennan, Sir Richard Glazebrook, Sir Joseph Petavel and Prof. Karl Pearson, discusses those remarkable changes of outlook which have characterized the development of physical science in the twentieth century. The evolution of molar mechanics along Newtonian lines; the extrapolation of the perceptual facts involved in the behaviour of macroscopic masses down to the dimensions of atomic magnitudes, and the success attendant on this extrapolation; the wave theory of light, which was so successful in co-ordinating old facts and predicting new ones as to draw from Lord Kelvin a noteworthy expression of his belief in the objective reality of the ether; these were outstanding contributions of nineteenth century thought to physical science.

Withal, there was considerable simplicity—not to say confusion—attendant on the definition of such a fundamental concept as that of mass.

With the closing years of the century, the discovery of the electron, of radioactivity, and the investigation of the manner of distribution of energy in the spectrum showed the existence of complexities and contradictions beyond the powers of the classical theory to explain or to resolve; and the last year of the nineteenth century saw the birth of those ideas which have given to our vocabulary a new verb—to *quantize*. The development is sketched of quantum notions as shown in the Rutherford-Bohr atomic model, the vector model of the atom, the dualism of outlook which emphasizes now the wave-aspect, now the particle aspect of matter and of radiation and the resolution of that dualism by the later developments of quantum mechanics.

Discussion of the new concepts introduced by the discoveries of the neutron and positron, and the positing of the neutrino to save conservation processes, leads to consideration in some detail of the development of the doctrine of causality and the definitions of *cause* given by Locke, Hume and Mill, the effect on the doctrine made by the enunciation of the uncertainty principle, and the attempt made by Planck to save the principle of causality.

* The Presidential Address, and addresses by the Sectional Presidents, are being published as "The Advancement of Science, 1936". (Blackpool; B.A. Reception Room. London: Burlington House.) Price 3s. 6d.

Is it possible for the plain man of science to order his daily work on a rational basis without of necessity becoming a technical metaphysician? The work of Karl Pearson, amended and extended to meet modern demands, points the way to a possible solution—a solution which, indeed, has some affinities with the endeavour of Prof. Planck to rescue the principle of causality. If the distinction is kept clear between the conceptual model, and the perceptual facts which the model is invented in order to subsume; if it is realized that the world-model, be it built up of billiard-ball atoms or probability-smears, in Euclidean or some esoteric form of hyper-space, remains a model still, and that, until any part of the model emerges into the region of perception, talk of its reality is rather beside the mark; if the twentieth century man of science is as ready to discard a worn-out model as ever Maxwell was, he is not likely to steer wide of the mark.

The man of science of to-day is called upon, more insistently than at any other period of history, to remember that he is a social animal. He can no longer continue to offer sacrifices at the shrine of the Idol of Purity; he must be prepared to consider the social repercussions of his work, whether these repercussions be eugenic or dysgenic. Section A has already initiated the consideration of such implications—it is hoped that the officers of the Section will continue to emphasize and to widen this aspect of the Section's work.

## Training the Chemist for Service to the Community

THE place of the chemist in the present-day community, and the manifold ways in which chemistry is involved in the solution of national and industrial problems, is the topic of the presidential address to Section B (Chemistry) by Prof. J. C. Philip. Any society which is intellectually alive will foster the spirit of inquiry, and the prosecution of research is perhaps the fundamental service which the chemist renders to the community. Mere accumulation of knowledge, however, which does not lead to action directly or indirectly is inadequate and unsatisfying, and it is because in the field of chemistry the academic search for new knowledge has led to such abundant practical achievement in the industry of the nation and the health of its citizens that the science deserves fuller recognition by the public.

It is a commonplace that discoveries at first of a purely scientific character have frequently turned out to have unexpected applications, and it has become clear that, so far as research and discovery in pure chemistry are concerned, a very long view indeed must be taken in assessing their practical value. Further, it must not be forgotten that a solution of even the most ordinary chemical problems on rational lines is possible only because of our accumulated knowledge of natural phenomena and natural laws. Work, therefore, in the field of pure chemistry builds up a reserve of knowledge and technique on which future generations can draw in attacking practical questions.

It is with this background that so much 'directed' research is prosecuted at the present time—research, that is, which aims at the solution of some specific problem of industrial or national significance. During the last twenty years there has been a notable expansion in the amount of directed research, and in this movement the State has taken a prominent share. Apart from the initiation of industrial research associations, the State has itself organized research on certain chemical problems of national importance, such as those connected with the utilization of fuel, the preservation of food, and the pollution of rivers. Many of these questions require the collaboration of men of science other than chemists, and indeed some of the most fruitful scientific investigations are co-operative in character.

Apart from research, very many trained chemists —the general practitioners of the chemical profession—are engaged in work of a more routine, but highly important, character, and their contribution to the smooth running of industry and to healthy living is far greater than most people realize. A study, indeed, of the occupations of chemically trained men shows that, in the industry of the country, the chemist is ubiquitous. This suggests that those who picture him as concerned mainly with explosives and poison gas have an entirely wrong perspective. The use of chemical substances for destructive purposes is a prostitution of knowledge and skill which chemists would like to see eliminated.

The great variety of the tasks with which the chemical profession is concerned means that the training of the chemist at our universities and colleges must be on broad, fundamental lines. The day, however, has gone by when chemistry could be treated merely as a philosophical discipline; so far as the service of the community is concerned, it is a practical science. The universities must accept the burden, as they have already done in medicine and engineering, of putting the vocational training of chemists on a broad foundation of scientific knowledge.

## Palæontology and Humanity

THE biological aspect of palæontology forms the topic of Prof. H. L. Hawkins's presidential address to Section C (Geology). The first part of the address is a re-statement of the basic facts about fossils, and is followed by an appraisement of their value in the attempt to decipher the history of life. Comparison of the records of palæontology and human history shows that fossils, for all their incompleteness, give on the whole a surer basis for historical reconstruction than documents or monuments. A corresponding comparison between the principles of taxonomy in palæontology and neontology shows inevitable differences that may lead to confusion if overlooked. Many of the characters of living organisms, rightly regarded as of specific value by neontologists, are quite inaccessible in fossil material; even when they seem to be recognizable, they cannot be proved to have a truly specific significance. In skeletal structures, differences that would justify taxonomic distinction between fossils can usually be matched with generic or even family differences in living organisms. Hence such terms as 'genus' or 'species' are used in different senses, and should be enclosed in inverted commas when applied to fossils.

Palæontology treats of the history of organic structures, not with that of the organisms themselves. Actually, this proves a distinction with very little difference, since organisms are dependent for their behaviour and welfare on the qualities of their component structures.

Analysis of the time-ranges of fossil groups leads to the conclusion that simplicity of structure, combined with reasonable efficiency, gives hope of longevity; while complexity of structure, in spite of its possibly greater efficiency, is relatively ephemeral. In the sphere of morphogeny, the meek inherit the earth and pride precedes a fall.

A review of the palæontological evidence of morphogeny shows 'orthogenesis' to be the prime factor in evolution, with environment acting as educator or executioner according to the plasticity of its victim. The impression gained may be summarized by stating that "the way life is lived is the way of evolution, whether it be from the Cambrian to the Holocene or from the cradle to the grave".

Mankind, viewed in palæontological perspective, appears in a dual role. He is a highly specialized member of a highly specialized class, and so seems doomed to a brief career. But his mental specialization seems to give him the all-round efficiency that is associated with generalization and its prospect of longevity. However, the historical record of human institutions has been, to date, an illustration

of the transience of the complex—typical in all but its speed. Man, when he plays the animal, submits to the fate normal to animals, and his exaggerated capacity only accelerates his doom.

With the mental acumen that enables mankind to be a supreme animal, there has developed a faculty that is different and unique. This faculty, which may be called 'altruistic', seems in many ways independent of, and perhaps triumphant over, environment. To man, the clever animal, palæontology points, albeit despairingly, to the precipice just ahead; but to man, the idealist, it has no message, save to welcome a new experiment that may perchance succeed in justifying the nobility of his aspirations.

## Natural Selection and Evolutionary Progress

THE subject of Prof. Julian S. Huxley's presidential address to Section D (Zoology) is the relationship of natural selection and evolution. On a Mendelian planet, such as ours appears to be, evolution is the joint product of mutation and natural selection. Recent work has altered our views as to the details of the process. The action of a particular gene depends on many other genes which act as modifiers; thus selection of the genic background is of great importance. By this means, deleterious effects of an otherwise advantageous mutation can be buffered or even abolished. Dominance and recessivity seem to be due to a similar action on recurrent mutations.

Analysis of this kind, however, only takes us a certain way. We must remember that evolution is a heterogeneous process, which will appear very differently to different groups of workers.

The origin of species is but one of the major problems of evolution: the others are the origin of adaptations and the origin and maintenance of long-range trends.

Species, it is now clear, can originate in several different ways. Their origin may be *unilinear*, when one species is wholly transformed into another; *divergent*, when one species diverges into two or more (as after geographical or physiological isolation); *convergent*, when a new species is formed by hybridization between two species (as in *Primula Kewensis*, *Spartina Townsendi*, etc.); or *reticulate*, when divergence and convergence combine to give a network of forms (as in roses, willows, and man). Furthermore, it may be either gradual or abrupt. The divergent origin of new forms after isolation appears always to be gradual, while their convergent origin (by allopolyploidy) after hybridization is always abrupt.

From the point of view of natural selection, speciation falls into two sharply distinct categories. When the characters distinguishing species arise abruptly, selection can have no part in deciding their nature: when they arise gradually, for example, after isolation, it can, and probably in large part does do so.

The origin of adaptations must be sought mainly in natural selection. Whenever an adaptation involves a number of steps or separate characters, no other agency but natural selection can have been operative. Thus, in the great majority of cases, pre-adaptation is ruled out. Natural selection is a mechanism by which results that otherwise would be in the highest degree improbable are rendered probable.

The origin and maintenance of long-range trends in all the numerous cases where the trend is towards functional specialization or improvement will be due to natural selection in the same measure as is the origin of adaptation. The directive character of such trends is no evidence of internally-determined orthogenesis, but is to be expected on a selectionist interpretation. Trends such as that of the elephants, in which the functional improvement is continuous, but the structural mechanism adopted is altered during the process, are incapable of orthogenetic explanation. A trend towards specialization will cease when certain biomechanical limits are reached to further advantageous advance.

Evolutionary progress may be defined as all-round advance in control over, and independence of, environment, while most long-range trends are one-sided specializations, and therefore blind alleys. Since it confers advantage, biological progress can equally be ascribed to natural selection.

Many evolutionary phenomena are better understood when it is realized that most genes act by controlling the rates of processes. In particular, many otherwise puzzling phenomena of recapitulation and anti-recapitulation at once become comprehensible. Anti-recapitulatory phenomena due to the slowing of early processes and the consequent removal of previous adult characters from the life-cycle are of great importance in evolution, accounting for neoteny, clandestine evolution, and fœtalization. This last process has been essential for the evolution of man: it is interesting that it could not have occurred in a polytocous form, where slowing of early growth would be prevented by intra-uterine selection.

An analysis of evolutionary progress reveals some interesting facts. In the first place, it appears that it could only have pursued the course that it has actually taken. Conceptual thought could only have arisen in a monotocous mammalian

type with an arboreal ancestry. Non-arboreal and polytocous mammals are excluded; so are birds and other terrestrial vertebrates; so are insects and all other invertebrate groups. No further biological progress is now possible, except in man. Another feature of progress is that characters essential for one progressive advance may be a handicap for later progress. This must be taken into account in planning further progress—that is, in any eugenic scheme.

## The Mapping of our African Colonies

THERE has been talk and correspondence lately on the backwardness of Ordnance Survey revision. Maps and Plans are not kept up-to-date and a great deal of inconvenience has been caused by this fact. It is becoming evident that town planning, building, road programmes and the like make up-to-date maps a necessity and not a luxury. It is not to be wondered at that similar problems have arisen in the African Colonies, the budgets of which have been just as hard hit as that of England. In his presidential address to Section E (Geography), Brigadier H. S. L. Winterbotham deals with this question.

The Ordnance Survey is strictly domestic. It has no duties outside the area for which our own parliamentary estimates are framed. The first step towards colonial mapping and surveying was taken in 1803, when the War Office formed the "Depôt of Military Knowledge" (maps were generally considered "military" in those days). In 1855 Lord Panmure, Secretary of State for War, arranged for a more energetic campaign, and he and the Secretary of State for the Colonies, working together, relied upon the same body, now called the "Topographical Department", to keep in touch with colonial survey departments and to intervene for their assistance, as often as possible. The colonial survey departments are concerned mainly with those property surveys which correspond to the large-scale plans of the Ordnance Survey, and the Topographical Department supplied officers and men for topographical mapping.

This dual arrangement has succeeded in providing a large area of good mapping, but it has failed in these post-War years to secure a proper and progressive programme of triangulation and mapping.

There is no question that comparatively enormous sums of money were squandered in England early in last century for lack of scientific forethought. The expenditure of two million pounds upon the unchecked and uncorrelated tithe maps is a case in point. The Grand Triangulation should, of course, have come first. In India the question was tackled sensibly and energetically in the correct sequence. In Africa the first essential is an arc of triangulation from Cape Town to Cairo, upon which all other surveys can be hung. Sir David Gill, H.M. Astronomer at the Cape early in this century, made a good beginning, and it was due to his personal foresight and vigour that this arc had reached the southern end of Tanganyika by 1914. Sir Charles Close added a portion in Uganda, and his whole-hearted co-operation as head of the "Geographical Section" (the new title of the Topographical Department) secured the skilled observers for the triangulation, and made it possible to map considerable areas at the same time. Before the Great War, more than 2,000 miles of the arc of triangulation had been finished. In exactly the same period (thirteen years), between 1922 and 1935, only 360 miles were added. In thirteen years before the War, 480,000 square miles were well mapped; in the thirteen years after, no more than 170,000 square miles.

The machinery exists, the problem grows more urgent in proportion as the development of local resources becomes more important. What seems to be lacking is the realization of the ultimate economy and wisdom of tackling the job in the proper sequence. Mapping and development are bound to go hand in hand.

## Problems of Plantation Economy

IN his presidential address to Section F (Economics and Statistics), Dr. C. R. Fay, who has just returned from a visit to the East, discusses the problems of plantation economy with special reference to the tea industry. The evolution of the plantation can be traced from the early tobacco and sugar plantations of North America, through the indigo plantations of nineteenth century India to the tea and rubber plantations of to-day in India, Ceylon and Malaya; and tea can be compared as a commodity with tobacco, sugar, coffee, rubber and forest produce in order to show the scope and method of the plantation form.

The tea estate usually has upon it a tea factory; and thus plantation economy presents two classes of production problems: (*a*) cultural problems connected with the growing of the leaf; and (*b*) industrial problems connected with the processing of the leaf into tea. Growing embraces the clearance and planting of the land, the cultivation of the plant and conservation of the soil, the plucking of the leaf. Processing involves the factory sequence of withering, rolling and breaking, fermenting, firing, sifting and packing. In the main, plantations are financed and managed by

Europeans; and there are four types of plantation to-day: the proprietary planter (now rare), the small company, the large company and the consumer company. In the last class, the English and Scottish Joint Co-operative Wholesale Society, Ltd., is important. The 'optimum' size of the estate is increasing; and the productive unit is in process of integration along two lines: (a) the combination of estates into 'groups' and (b) the association of estates with coastal agency houses, which have functions of buying, selling, technical supervision and financial control.

The tea estate carries an important labour force, and its labour problems are threefold: recruitment, wages, health and housing. These vary according to the district, and the conditions in Assam, South India and Ceylon differ. Ceylon in 1934–35 was visited by a malaria epidemic, which attacked a large section of the tea area and created conditions of famine in villages adjacent to the estates. It was caused by a period of prolonged drought, and the measures by which it was fought are revealed in the official documents of 1935 and 1936.

Since 1933 South India and Ceylon have participated in the international scheme of tea export control. Regulation of export means restriction of production. It presents difficult problems, but it came in an industry which was already accustomed to joint action in other fields—in the regulation of labour, the provision of medical services and the undertaking of technical research, which in Ceylon is conducted at the St. Coombs Research Institute. In effect, the new control regulation is voluntary group effort, endorsed by the State. Tea control (1933) was followed by rubber control (1934), and both schemes are distinguished by the fact that, unlike the post-War rubber scheme, they include the Dutch East Indies.

The nature of regulation in plantation commodities can be compared with that in forest produce, where the problem of conservation is uppermost.

## The Engineer and the Nation

IN his presidential address to Section G (Engineering), Prof. W. Cramp avoids technical matters, and confines himself to a review of the relationship between the engineer and the nation. The engineer shares with the devotee of pure science the detached pursuit of truth, but his work, like that of the doctor, is practical in its aspect, and entails not only daily contact with humanity, but also an understanding of human desires and of human psychology. This dual role gives him a greater opportunity both for the development and for the loss of character, but it also makes him more balanced and adaptable than his colleague in pure science.

Engineering at its best is the greatest instrument of civilization that the world has ever seen, because it is so largely concerned with the development of means of communication. Its natural tendency is to promote a closer contact between individuals and nations, but when deflected from this path of peace, it may equally become a terrible agent of destruction and death. For these reasons the activities of the engineer and the uses to which they are put are matters of supreme importance. To what extent does the nation recognize its responsibility towards the engineer, and how does the engineer respond?

The attitude of the nation towards the engineer is reflected in the status, protection and remuneration that are accorded to him. A sharp contrast exists between his position and that of the medical man, whose period of training is only a little longer and whose responsibility is probably less. By means of his professional organization with statutory powers, the doctor has acquired a proper status with perhaps too much protection. At present the engineer has liability, without appropriate status, remuneration or protection.

The responsibilities of the engineer are emphasized by the charges brought against him by pulpit and press. Of these the first is the statement that engineers lend themselves too willingly to works of destruction. The answer is that pure science recognizes no moral distinctions, so that this is a matter of individual conscience in which the engineer is on a par with the rest of mankind. The second is the suggestion that a moratorium should be imposed upon scientific development; to which the answer is that the invention of a machine does not compel its use. The third charge against the engineer is his lack of fertility in producing inventions which might lead to new industries. This is explained by the clumsy, costly and ineffective protection of patentees and by the absence of scientific representatives upon governing bodies in the State and in industry. In both directions reforms are needed.

The attitude of the engineer towards the nation involves professional conduct, both individual and collective. There have been engineers whose opportunities of acquiring a high standard of values were ideal, yet they surrendered integrity to self-interest when temptation arose. Among collective activities, mention may be made of the growth and development of trade associations; and of the dangers inseparable from powerful monopolies. The action of such groups in developing and maintaining a high standard of quality is gratefully acknowledged, but it is suggested that there is also some evidence of a tendency to exploit

the nation for the benefit of a particular industry. This, if not checked, will react to the detriment of the associations themselves.

Conclusions drawn from the whole analysis suggest a number of reforms. These are: (1) The establishment of an engineering body with statutory powers to prevent unqualified persons from jeopardizing life and to check unprofessional conduct; (2) the proper representation of science in State and municipal departments; (3) a drastic revision of patent procedure in the law courts; (4) voluntary renunciation by trade associations of any advantage unfair to the nation; (5) an inquiry by educational experts into the best means of inculcating a higher scale of integrity among members of the profession. Of these reforms, it is suggested that the British Association might lend its aid in connexion with the second, third and fifth.

## Cultures of the Upper Palæolithic

MISS D. A. E. GARROD deals in her presidential address to Section H (Anthropology) with the Upper Palæolithic in the light of recent discovery. The last twelve years have seen a new impetus given to prehistoric studies by the multiplication of researches outside Europe. This has led to a partial revision of the classification of Palæolithic cultures associated with the name of de Mortillet. In particular, it is becoming clear that the old division into Lower, Middle and Upper Palæolithic has a chronological value only, and that for purposes of typology the fundamental division is into hand-axe, flake and blade cultures.

In considering the present state of our knowledge of the blade cultures one point emerges clearly—the diversity of the strains which have hitherto been grouped together under the heading of Aurignacian. This is borne out by Peyrony's researches in the Dordogne and by recent work in the Near East, which lead to a distinction between the industries characterized by the blunted-back blade, formerly classified as Lower and Upper Aurignacian, and the Middle Aurignacian, in which the type-implements are steep and rostrate scrapers. Peyrony suggests that the first group should be labelled Perigordian, and that the old name of Aurignacian should be kept for the second.

A study of recent excavations, more especially in Russia, the Near East and North Africa, suggests that the problem is extremely complex, and a new system is tentatively put forward. The former Lower Aurignacian is named Chatelperronian, the Middle Aurignacian remains as Aurignacian proper, and the former Upper Aurignacian is divided into Lower and Upper Gravettian, corresponding to the La Gravette and Font-Robert levels respectively. The origins of the Chatelperronian can be traced back into the Lower Palæolithic, both in Palestine and East Africa, and it is suggested that its centre of origin lies somewhere in south-west Asia. It may have given rise to the Capsian, by way of the Kenya Aurignacian, and may also have passed northward to develop into the Gravettian, which is abundant in Russia. The Aurignacian proper, on the other hand, shows a remarkable development in the Near East, and the Iranian plateau is suggested as a possible centre of dispersion.

We thus have three major provinces for the blade-cultures: the Capsian in Kenya and Little Africa, and the Gravettian in north-west Asia and eastern Europe, both possibly derived from the earlier Chatelperronian, but cut off from each other by the great Aurignacian province of the Near East. From the Gravettian and Aurignacian centres migrations pour into central and western Europe, and cultures which in their homelands tend to remain distinct succeed and influence each other until at the extreme limit of their journey we get the classic French sequence. The industries which mark the extreme end of the Pleistocene, such as the Magdalenian, etc., appear to be local developments of one or other of these stocks, while the Solutrean is an intrusive element, of Hungarian origin.

## Circulation of the Blood

THE control of the circulation of the blood, which is such an important problem in relation to surgical shock, forms the subject of the presidential address of Prof. R. J. S. McDowall to Section I (Physiology). Only a few years ago the subject consisted of a large amount of little-related data, but gradually this is being pieced together. For example, the well-known and dramatic fact that stimulation of the vagus nerve will slow up or even stop the heart, is now recognized as indicating part of a mechanism by which the normal heart at rest is constantly subjected to restraint, the release of which results in cardiac acceleration such as occurs in exercise.

The requirements of physical exercise probably give the best indication of most of the mechanisms of the circulation. In the active muscles a number of chemical and nervous mechanisms bring about a dilatation of blood-vessels locally. That the sympathetic vasodilators are in part responsible for the dilatation is a recent development. At the same time, largely as a result of psychical activity, blood-vessels are shut down in less active parts such as the alimentary canal and the skin. This has hitherto been considered to be due to the

action of the vasoconstrictor nerves, but it is now shown that probably there is a reduction of the general vasodepressor reflexes which arise from the carotid sinus and the cardio-aortic region. The evidence rests on the fact that severance of the reflex arcs results in increased venous flow and cardiac output, while circumstances which reduce vagus activity also reduce the activity of the general vasodepressor reflexes. Thus just as the vagus may be looked upon as determining the range of cardiac activity, so the depressor reflexes determine the amount of blood available for the heart.

Hitherto, it has been considered that these two mechanisms are concerned primarily with the maintenance of a mean arterial pressure, but several facts suggest that in exercise the loss of their sustained activity is of more importance than their maintenance. These are their great variability in different animals and under different experimental conditions, the profound effect of loss of the vagus on efficiency in exercise and the fact that the arterial blood pressure rises in spite of these mechanisms.

## The Patterns of Experience

THE controversies in which psychologists are now engaged are a sign of life and progress in the science, but an eclectic position is reasonable, provided that one maintains a point of view sufficiently unifying to avoid the danger of becoming a mere collector of odds and ends of fact and theory. Such a point of view appears to be afforded by the hypothesis of mental schemata, originally suggested by Sir Henry Head, and since advanced in other connexions by Prof. F. C. Bartlett and Mr. A. W. Wolters, who has chosen this topic for his presidential address to Section J (Psychology).

At the Norwich meeting of the British Association, Prof. E. Rubin demonstrated that there are predetermined 'ways of seeing', and that perception can be shaped by factors extrinsic to the material experienced. Under the influence of such factors, the mind actively patterns its experience, so informing the sensory material as to make the percept consistent with certain subjective principles. This implies that the patterns of experience are already latent in the subject's mind as he confronts the world. How they can so exist is partly explained by a consideration of the patterns of behaviour as exhibited in instincts and skills. The first necessity of every organism is to remain alive, and this task requires that it should master its environment and make it manageable. To this end it develops skills, which are qualities of the organism in virtue of which it is prepared to deal more adequately with situations of a particular kind, though prepared only in an outline, flexible manner. Such a preparation for reaction, dependent upon the integrated effects of previous experience, has been termed a *schema*, and it now appears that Rubin's 'ways of seeing' can be brought under the same conception. Thus perception, memory and conceptual thinking have been brought under common principles. They are reactions preliminary to further behaviour, and depend upon the existence of pre-formed schemata.

The same conception can be applied to problems of social psychology, for society is only actualized in its impact upon individual lives. Society becomes a psychological datum because it exists immanently in the minds of its members. A social group exists as such in virtue of conative tendencies developed by individuals in the course of accommodating their behaviour to each others', so that an observable group pattern is the product of the skill-characters, or behaviour schemata, of the constituent members. Often the schemata are not open to inspection or description, having been developed for other purposes. The difficulty of stating the principles underlying the English Common Law is psychologically explicable if it is considered that they are the ways of living together developed by a nation.

The subject-matter of psychology is taken to be the activities of the individual organism striving to maintain its full integrity. To obtain control of its universe it must organize the material of experience into patterns manageable by it. To this end it develops skills which we have termed schemata, and the system of a person's schemata embodies all his experience up to the present moment, and determines the direction and pattern of his future experiencing. Thus in outline the 'ways of seeing' and the 'ways of living' are reducible to a common psychological genus.

## Uses of Fungi

IN his address to Section K (Botany), Mr. J. Ramsbottom deals with many of the ways in which fungi have proved useful to man.

Edible fungi have been known from the earliest times, but only three species have been successfully grown on a large scale—the common mushroom (*Psalliota campestris*) in Europe and America, shiitake (*Cortinellus Shiitake*) in Japan, and *Volvaria volvacea* in many parts of the tropics.

Wood infected with fungi is used for various purposes, the green wood of Tunbridge Ware being the best known—the colour being due to the mycelium of the discomycete, *Chlorosplenium aeruginosum*; 'brown oak', much valued by

wood-workers, has recently been shown to be due to infection by the beef-steak fungus (*Fistulina hepatica*), and wood rotted by *Mucor racemosus* is used as cattle food (*palo podrido*) in Patagonia.

The lack of chlorophyll imposes upon fungi their peculiar physiology, which has many consequences important to man. Every nation has its fermented drinks or foods, mostly dating back to antiquity. Sometimes the fermentation is brought about by one or more yeasts, sometimes by a 'symbiotic' combination of yeast and bacteria. Many of the processes which were formerly left to chance are now controlled to a greater or less extent, and pure cultures of yeasts are employed. Similarly in cheese-making the appropriate species of the mould *Penicillium* is used for ripening blue-streaked cheeses (Stilton, etc.) and cream cheeses of the Camembert type.

While yeasts are the chief agents of fermentation in the West, Mucoraceæ and species of the *Aspergillus flavus-Oryzæ* group are mainly concerned in the East. The importance of *Aspergillus* in the preparation of soy sauce (the basis of many table sauces), saké and other products is shown by the estimated annual value to Japan as £40,000,000.

Recently there has been considerable development of the use of fungi in industry. Takadiastase produced by *Aspergillus Oryzæ* and its allies has many commercial uses as well as in medicine. Citric acid is now manufactured in many countries on a large scale by the action of dark-spored Aspergilli on sucrose, nine acres of mycelium being said to be held in commission by one American firm for use in cheese-making alone. Gluconic acid, now being used in increasing amounts as the calcium salt, which is more satisfactory for many purposes than is calcium lactate, is obtained on a commercial scale by the action of *Penicillium* species, for example, *P. chrysogenum* on commercial glucose.

During the Great War, Germany obtained her supplies of the glycerol necessary for the production of high explosives by trapping the intermediate products of sugar fermentation by yeasts; other countries developed similar methods. To supplement her inadequate bread ration, Germany employed *Torula utilis*, "mineral yeast", which is a poor fermenter but which grows readily on molasses, 100 gm. of this producing 130 gm. of yeast in eight hours. Russia also used a non-fermenting yeast, *Endomyces vernalis*, 'fat yeast', for food, the fat formed reaching 15–28 per cent of the dry weight in 10–15 days.

Many processes in which fungi play a part have been patented, and specifications cover the making of leather substitutes by tanning gelatinous growths, the artificial ageing of green coffee, the production of ergosterol, acetone, fumaric acid and so on. Substances which have not previously been obtained have been produced by the action of moulds, and it is evident that compounds of almost every type known to organic chemistry can be synthesized.

## The Future in Education

IF we consider that the goal of education is the making of men and citizens, that body, character and (in the widest sense) reason make the man, and need to be developed and trained, and that human beings cannot live intelligently in the world without some knowledge of literature, history and science, then we must admit that in spite of great achievements during the past sixty years in elementary, secondary, technical and university education, we have not produced an educated nation. We have provided opportunities for the minority who attend secondary school and university. Most of the rest have had no regular instruction after they leave school at fourteen years, an age when education in the real sense is about to begin, and this, according to Sir Richard Livingstone's presidential address to Section L (Education), is our great educational scandal and problem.

To solve it, two principles, commonly ignored, must be observed. First, it is useless to teach a subject before the mind can digest it. A liberal education cannot be given at the age of fourteen, fifteen or sixteen years. Secondly, the humanistic subjects—literature, history and philosophy—cannot be properly appreciated without some experience of life. In this they are unlike physical science and mathematics, which need no such experience. But if these principles are sound, our problem will not be solved by raising the school age to fifteen years; indeed, even an education which stops at the age of seventeen or eighteen is quite incomplete. Unless we are content to have a largely uneducated nation, we must establish part-time compulsory education to the age of eighteen years, and follow this up by adult education. Thus and thus only can we secure that the whole nation has a chance of being educated.

The great successes of adult education in England are the Workers' Educational Association and the university extension movement. The former provided for the working-class intelligentsia, but left the masses untouched. If we are to reach them, we must develop a different, less academic, technique in adult education. In particular, we need to study the intellectual digestion of the average man (which is different from that of the intelligentsia), and also to develop the social, corporate element in education. On these points we can learn from the Danish folk high-schools

and from the women's institutes, both of which reach a class which our adult education has largely failed to touch.

The future lies with adult education. Without it the masses will remain uneducated. But it is also needed for the 'educated classes', and an attempt should be made at the universities to provide opportunities for regular study by professional men, civil servants, politicians and others, whose systematic study and thinking is apt to end when they take their degree. Summer schools, doctors' 'refresher' courses, etc., are rudimentary forms of such study, which have evolutionary possibilities.

## Soil Science

THE advances which have been made in soil science in the twentieth century are discussed in his presidential address to Section M (Agriculture) by Prof. James Hendrick. At the beginning of this century, agricultural research was in a low state in Great Britain, where there was only one great research station, a private institution, Rothamsted. That has now been altered and, under the guidance of the Development Commission, a system of agricultural research stations has grown up covering all the leading branches of agricultural inquiry. The development of the system of agricultural education has led to increase and improvement of agricultural research.

In the great advance which has taken place in agricultural investigation, the fundamental subject of soil science has received much attention, especially since the Great War. A great part of the inspiration has come from foreign sources. In all parts of Britain the climate is temperate and humid with a rainfall distributed over all parts of the year, but in a great country like Russia the climate varies from arctic to sub-tropical and from humid to arid and desert. The Russians studied soil formation and classification from the point of view of climate, and showed how greatly the character of the soil depends upon climate. Cut off as the British were from Russia by linguistic, political and geographical barriers, nothing was learned of this until after the Great War. Though the British Empire extends through an even greater range of climatic conditions than Russia, little account was taken of the influence of climate on soil formation, and classification was based more on geology. A revolution has taken place in our views since the development of international soil congresses has established contact with the soil scientists of Russia and other countries, and attention is no longer confined to the comparatively narrow range of soils found in the British Isles.

Another field in which great advance has been made in recent times is in our knowledge of base exchange and soil acidity, and in the application of colloid chemistry to the study of the soil. Calcium carbonate has lost, to the exchangeable bases associated with the soil colloids, much of the high place it used to occupy in agricultural chemistry.

The two great classes of colloids found in the soil are the mineral colloids of the clay and the organic colloids of the humus. Much advance has been made in unravelling the structure of the clay colloids, but the exact nature and structure of the humus colloids is still obscure.

Another sphere in which great advances have been made during the present century is in the manufacture of, and trade in, fertilizers. In the case of nitrogenous fertilizers, this has amounted almost to a revolution.

## Preservation of Native Floras

THE preservation of native floras with special reference to the British flora is the topic of Dr. A. B. Rendle's presidential address to the Conference of Delegates of Corresponding Societies. The preservation of native floras is of high importance from a scientific point of view. The cases of St. Helena and the Bermudas are examples of interesting natural floras that had been largely destroyed by man's action, especially by the destruction of the trees and the introduction of alien plants which had proved superior in competition with the natural flora. But efforts should be made to preserve what remains. It will be a reproach to us if the only material for study by future students of a flora is that found in herbaria.

Our British flora is worth preserving. We cannot regard it as merely a part of the west European flora that invaded Britain after the disappearance of the glacial ice before we were cut off by sea. There is evidence for the survival of fragments of the original flora in sheltered unglaciated spots during successive periods of glaciation, and various elements of special interest may be associated with special areas that presumably remained open. Intensive work on British genera and species indicates that there is still scope for investigations of taxonomic, distributional and ecologic interest. Apart from an æsthetic point of view, there is good reason for efforts to preserve our flora, even though it has already been much changed by the action of man and his crops and herds.

Various means to ensure conservation can be used. The Plant Conservation Board of the Council for the Preservation of Rural England, in

particular, does important work. Three methods of promoting conservation are available: legislation, education and Nature reserves. The last was fully discussed by Sir David Prain in his address to the Conference at the York meeting of the British Association. Its value in the preservation of areas of special types of vegetation such as an alpine flora, that of a Yorkshire dale, or a fenland such as Wicken or Chippenham, or smaller special areas, is inestimable. But the Nature reserve will not preserve the flora of the countryside as a whole, and here we are concerned with legislation and education. The former is only the next best thing, but until the community is educated to leave for the enjoyment of all that which appeals to the individual, some form of legislation seems necessary. The Conservation Board has enlisted the help of local Councils throughout the country and their response has been encouraging. Posters appealing for the preservation of wild plants have been very widely distributed, and the by-law approved by the Home Office forbidding uprooting on land to which the public have right of access has been adopted and copies have been posted in prominent places. Lists of species demanding special protection in individual counties, on account of beauty or rarity, have been prepared and circulated.

Up to the present it has not been found possible to frame a by-law for the protection of wild plants growing on private property.

Plants may be studied as growing; uprooting is rarely necessary, and, if it is desirable, permission from the owner of the land may be obtained.

The introduction of our native species by planting or sowing in places in which they have never been known to grow wild is strongly to be deprecated. A natural harmony is disturbed and the introduced species may oust other species or even increase to become a nuisance. Introduction of alien plants in wild localities, and indiscriminate seed scattering are thoroughly reprehensible.

Education of the adult is difficult. He is not interested, but may be reached by appeals or occasional talks by the B.B.C. and by helpful articles and notes in the public Press. The botanical collector who wants rare species for his herbarium or for exchange purposes is even more difficult to convert. Education of the children, instilling a love and respect for our wild flowers, seems the most hopeful method. A pamphlet on "The Protection of Wild Flowers" has been widely distributed by the Conservation Board among school teachers. Every school should, where possible, have a garden in which the children are encouraged to grow wild plants from seed and note their development. Flora's League publishes an admirable booklet by Mr. T. A. Dymes with full instructions for growing wild plants from seed.

The active co-operation of everyone interested is necessary if the movement is to succeed.

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### Dartford-Purfleet Tunnel

BELOW Blackwall tunnel, which is thirty-five miles from the mouth of the Thames estuary, there are no facilities for crossing the Thames either by bridge or tunnel. The construction has now been approved of a tunnel, which will be called the Dartford-Purfleet tunnel and will connect the Purfleet-Grays Road on the north side of the river with the Dartford Southern by-pass, and a connexion will then be made with the London-Folkestone and the London-Hastings roads. As a first step (*Roads and Road Construction*, September 1), a pilot tunnel will be constructed 900 yards in length and with an internal diameter of 12 feet. Two ventilating shafts with diameters of 18 feet will be constructed on the Kent and Essex banks of the river. They will be approximately 100 feet in depth. The pilot tunnel will cost £300,000 and will provide information as to the strata under the river at this place. This will be very helpful in connexion with the construction of the main tunnel. The tunnel will be rather more than a mile in length. The cost of the whole scheme is estimated to be about three million pounds, the pilot tunnel costing about a tenth of this. The Ministry of Transport, which will be directly responsible for carrying out the work, has made, in conjunction with the county councils of Essex and Kent, all the necessary arrangements. This tunnel, which will be twelve miles down the river from the Blackwall tunnel, will form a much-needed link between the north and south sides of the Thames Estuary.

### Electrical Accidents in 1935

THE report on electrical accidents in 1935 by H.M. electrical inspector of factories (London: H.M. Stationery Office. 9*d*.) is of special value to all who design and operate electrical apparatus. The total number of accidents reported under the Acts was 447, of which 23 were fatal. Although the use of electricity has doubled during the last ten years, the annual total of the number of accidents has varied very little. The total number, twenty-three, of fatal accidents on factory premises is eight less than last year. This is probably due to the much larger use now made of artificial respiration when attempting to revive the victims of electric shock. In successful cases the time of application necessary varied from a few minutes to half an hour. Last year there were nine successful cases, but if it had been tried in every case there would doubtless have been more, as signs of life in some of the cases which ended fatally were evident after the shock. The inspectors specially mention the very rapid growth of electric arc welding to structures of all kinds. Although there were thirty-six electrical accidents to electrical welders, none of them was fatal. This is probably largely due to the attention now being paid to the personal equipment of the operator. Gauntlets, hand screens and helmets are made of suitable insulating materials, and are standardized. In addition, the harmful effects produced on the eyes of workmen not concerned in the welding processes, but liable to flashes from an arc in their vicinity, are considered. It has been found that plain glasses cut off a large proportion of the harmful ultra-violet rays. Until they had experienced the painful effects of eye flash, workmen were reluctant to wear them; in works where they are used, eye trouble has been eliminated.

### New Conceptions of a Rock Garden

ENGLISH gardens have been enriched with many beautiful herbaceous plants from South Africa, but the succulent and xerophytic species of that region are not yet common in England. The rockery which is being made in Johannesburg for the Empire Exhibition of September, 1936–January, 1937 should provide an adequate portrayal of South Africa's wonderful endowments in these sections of its flora. Prof. John Phillips, professor of botany in the University of the Witwatersrand, describes the rockery in the *Journal of the Royal Horticultural Society* of August, 1936. It is planned upon a scale which is somewhat gigantic when judged from most English standards. Summits are broken with plantings of *Aloe Marlothii*, *A. dichotoma*, and other species, whilst the most striking effects are produced by the mesembryanthemums, the euphorbias, members of the genus *Encephalartos*, the pelargoniums, and by *Aster capensis*, *Dimorphotheca Ecklonis* and *Euryops athanasia*. A stream, rushing from the rock garden into the lake below, affords opportunity for the planting of indigenous hygrophilous plants, and lawns of *Cynodon* sp. and *Pennisetum clandestinum* have been laid. Large woody shrubs, and even small trees, such as *Chilianthus arboreus*, *Rhus lancea*, *Dombeya rotundifolia*, *Cussonia spicata*, *Tecomaria capensis*, *Plumbago capensis*, and other species, are employed for certain effects. Mr. Frank Frith, an expert on succulents, is supervising the making of the rockery.

### Early Man in Colorado—Further Investigations

EARLY in June, Dr. Frank H. H. Roberts, jun., of the Smithsonian Institution, Washington, D.C., resumed excavations on the Lindenmeier site in northern Colorado for the third consecutive summer (see NATURE, Oct. 5, 1935, p. 535). While this habitation or camp site of Folsom man, the only known site of its kind and the only source of more than isolated specimens of the characteristic grooved stone Folsom point, has produced an abundance of evidence of the mode of life of Folsom man, hitherto no human skeletal remains have been found in association with this culture. Dr. Roberts's investigations during the coming season, therefore, will be devoted especially to the search for human skeletal remains. That early man was a contemporary of the extinct forms of bison found on the Lindenmeier site and dating possibly from the last stages of the Ice Age, is incontestable, as the tip end of a point was discovered in the foramen of the spinal column of a bison, of which a considerable portion of the skeleton was uncovered with the bones still articulated. A further matter of interest is that the palæontological evidence obtained by Dr. Roberts points to a climate somewhat warmer than that of the present day, some of the invertebrates represented by fossils being considerably north of their present range.

**Bureau of Human Heredity**

THE object of the Bureau of Human Heredity, which has recently been founded (see NATURE, 137, 795; 1937), is collection on as wide a scale as possible of material dealing with human genetics. Later, the tasks of analysis of material and distribution of the information available will be added. It is affiliated to the International Human Heredity Committee, which ensures co-operation in all areas where research is proceeding. The Council would be grateful to receive all available material from institutions and individuals, furnishing well-authenticated data on the transmission of human traits whatever these may be. Pedigrees are particularly desired; twin studies and statistical researches are also relevant. Announcements in regard to the services undertaken by the Bureau will be published from time to time. The address of the Bureau is 115 Gower Street, London, W.C.1.

**Announcements**

DR. H. R. MILL has been elected a member of the German Academy of Naturalists at Halle "in recognition of his original contributions to geographical science and particularly to Oceanography and the furtherance of Polar research". This Academy, the full title of which is the Kaiserlich Leopoldinisch-Carolinisch Deutsche Akademie der Naturforscher, was founded at Schweinfurth in 1652 by a group of medical men who called themselves the Argonauts, as their object was to explore new realms of science in order to bring back the 'gold of knowledge' for the benefit of mankind, an aim which it now defines as the study of Nature for the good of humanity.

MR. R. A. WATSON WATT has been appointed superintendent of the Air Ministry Research Station, Bawdsey Manor, Suffolk. Mr. Watson Watt began his Civil Service career in the Meteorological Office, and later was appointed superintendent of the Radio Research Stations of the Department of Scientific and Industrial Research at Aldershot and Slough. He became superintendent of the Radio Department of the National Physical Laboratory when it was formed in 1933. In this post he has been responsible for an increasing amount of important work for the Air Ministry, especially in connexion with radio direction finders and beacons. His present appointment arises from a decision by that Department to establish a research station to continue this work.

PROF. FRANZ FISCHER, of the Kaiser-Wilhelm Institute, Mulheim-Ruhr, will deliver the Melchett Lecture of the Institute of Fuel at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, on October 15, at 3.30 p.m. The subject of Prof. Fischer's lecture will be "Production of Synthetic Motor Spirit".

THE Prussian Academy of Sciences has awarded the gold Leibniz medal to Prof. Heinrich Lotz, of Berlin, and the silver Leibniz medal to Dr. Ludwig Kohl-Larsen, of Allensbach a. Bodensee.

PROF. REINHOLD RIEKE, director of the Chemico-Technical Experimental Institute of the German Porcelain Factory of Berlin and scientific director of the German Ceramic Society, has been nominated an honorary member of the American Ceramic Society.

IN connexion with the research item in NATURE of July 11, p. 83, on the Netherland's Meteorological Institute's publication, "Oceanographic and Meteorological Observations in the China Seas", Mr. H. Keyser, of De Bilt, writes that for the English text very valuable assistance was given by Mr. E. W. Barlow, of the Marine Division of the Meteorological Office in London, who took much trouble in correcting the manuscript, etc. Mr. Barlow has also given assistance, "on behalf of international co-operation", in the preparation of Part 2 of the work.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An inspector of agriculture in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (September 15).

Two junior investigators for the Royal Commission on Historical Monuments—The Secretary, 29 Abingdon Street, London, S.W.1 (September 19).

An assistant horticultural instructor for the Hampshire County Council—The Clerk, The Castle, Winchester (September 21).

An assistant lecturer in electrical engineering in University College, London—The Secretary (September 23).

An instructor in engineering workshop practice and production engineering in the Borough Polytechnic, London, S.E.1—The Principal (September 23).

A head of the Production, Engineering and Trades Course Section of the Department of Mechanical Engineering, and a lecturer in metallurgy, in the Central Technical College, Birmingham—The Chief Education Officer (September 26).

An assistant conservator of forests in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (September 30).

A biologist for research in the eastern Canadian lobster fishery—The Director, Atlantic Biological Station, St. Andrews, N.B., Canada.

A temporary assistant engineer in the Experimental Section of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, London, S.W.1.

Architectural and structural engineering assistants in the Design Branch of the Directorate of Fortifications and Works at the War Office—The Under-Secretary of State (C. 5), The War Office, London, S.W.1 (quote 8314).

An assistant master to teach zoology in the Swansea Technical College—The Director of Education, Education Offices, Guildhall, Swansea.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 469.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Conservation of Energy in Radiation Processes

AT the beginning of this year, R. Shankland[1] reported experiments on the Compton effect which indicated a breakdown of the conservation laws in radiation processes and a reversal to the type of theory put forward by Bohr, Kramers and Slater in 1924. According to the latter, light-quanta have no existence, and energy is only statistically conserved in the interaction of matter and radiation. In view of the difficulties of accepting Shankland's results—it was pointed out by one of the present writers in an earlier note[2] that they "run counter to the Uncertainty Principle"—we have carried out certain experiments with a view of testing further the points at issue.

In these experiments, which were referred to in the above-mentioned note, a narrow beam of X-rays ($h\nu \sim 20{,}000$ volts) is passed through a Wilson chamber containing argon, thus producing photo-electrons. Of the photo-electrons which come from the $K$-level, the great majority are accompanied by Auger electrons, the latter being produced by the process of internal conversion (the combination of the two tracks will be called a $P$ track and represented in Fig. 1 by $\wedge$). The remainder of the $k$-photo-electrons—about 1 in 13—are not accompanied by Auger electrons ($Q_1$ tracks, denoted /). On the light-quantum theory, and strict conservation, the ionized atoms which do not give Auger electrons emit a $k$ fluorescent quantum, which, if absorbed in the surrounding gas, produces a photo-electron ($F$ track, denoted ↘). This state of affairs is represented in Fig. 1, the dotted line being the path of the light-quantum.


FIG. 1.

Now the ionized atoms have ***exactly the same durations in the excited state*** whether they give rise to an Auger electron or not, and on the theory of statistical conservation such as the Bohr-Kramers-Slater theory, they 'emit' fluorescent radiation to exactly the same extent, and ***are equally responsible for the production of the fluorescent F tracks.*** The latter would therefore not be associated with a $Q_1$ track any more than with a $P$ track, while if there is strict conservation an $F$ track has nothing to do with a $P$ track. A test of the points at issue may therefore be made by seeing whether a track of the $Q$ type is systematically associated with a fluorescent track or not. A statistical examination is necessary, especially in view of the fact that the photo-electrons coming from the $L$ level ($Q_2$ tracks) are not distinguishable in the photographs from the $Q_1$ tracks, and are about equal in number.

Out of about 350 photographs (about 10 tracks per photograph, effective length of chamber $\sim$ 14 cm.) 21 were found with $F$ tracks within 2 cm. of the

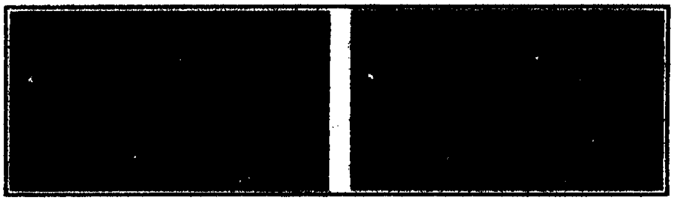

FIG. 2.

primary X-ray pencil, in approximate accordance with the value of the absorption coefficient of argon for argon $k$-radiation, the argon being at a pressure of about 14 cm. A general inspection of the photographs showed a distinct association of $Q$ and $F$ tracks, indicating strict conservation. One of the photographs is reproduced above (Fig. 2), the short track by itself being that of a fluorescent photo-electron ($F$ track) and the middle long track that of a primary photo-electron without an Auger electron ($Q$ track).

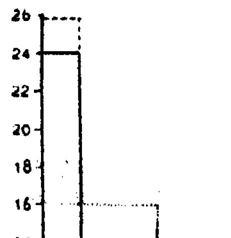


FIG. 3.

The distribution of the distances ($x$), measured parallel to the X-ray pencil, of the $Q$ tracks from the $F$ tracks for all the photographs is shown by the full line in Fig. 3, for $x$ up to 6 cm. The calculated distribution according to strict conservation is represented by the broken line (– – –). The peak for small $x$ represents the association of $Q_1$ and $F$ tracks. The background is to be attributed mainly to the photo-electrons from the $L$-level ($Q_2$ tracks). The statistical fluctuation comes almost entirely from this background and is about $\pm 1\frac{1}{2}$. The total number of tracks per photograph is such that on the statistical theory the $Q$ tracks have practically a random distribution with respect to the fluorescent photo-electrons. This is represented by the dotted line (. . . . . .). The observed distribution is seen to have a peak in good agreement with the calculated distribution assuming strict conservation.

In view of Shankland's results, other workers have also recently carried out experiments on the conservation of energy and momentum in radiation

processes[3]. In these investigations the counter coincidence method has been used. In all cases the results obtained, in conformity with the present results, confirm the light-quantum theory and the strict applicability of the conservation principles.

E. J. WILLIAMS.
E. PICKUP.
Physical Laboratory,
Manchester.
Aug. 7.

[1] *Phys. Rev.*, **49**, 8 (1936).
[2] NATURE, **137**, 614 (1936).
[3] Bothe and Maier-Leibnitz, *Göttingen Nacht.*, **10**, 127 (1936).
4. C. Jacobsen, NATURE, **138**, 25 (1936). Present results were reported at Physics Conference, Zurich, July 1.

## Influence of Temperature on the 'Groups' of Slow Neutrons

WE have investigated the influence of temperature on the activation of silver by slow neutrons, separating the effects due to the groups $A$, $B$ and $C$ as defined by Amaldi and Fermi[1]. The arrangement used is shown in plan in Fig. 1. Absorbers of cadmium

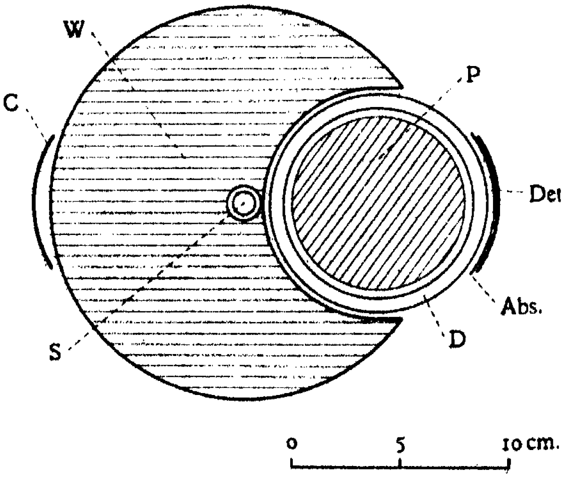


FIG. 1. $S$, neutron source (beryllium and radon); $W$, tin containing water; $D$, Dewar vessel; $P$, paraffin wax; *Det.*, silver detector; *Abs.*, cadmium and/or silver absorbers; $C$, position of detector for comparison runs.

(0·258 gm./cm.$^2$) and silver (0·077 gm./cm.$^2$) were employed to separate the groups, and the use of a thicker absorber of silver (1·023 gm./cm.$^2$) enabled changes in the absorption coefficients of groups $B$ and $C$ in silver to be measured. For the low temperatures the paraffin wax was cooled with liquid nitrogen or hydrogen. The results obtained were as follows:

| | Group | 290° K. | 77° K. | 20° K. |
|---|---|---|---|---|
| Activity induced | $C$ | 100·0 ± 1·4 | 83·7 ± 1·3 | 96·4 ± 1·2 |
| | $B$ | 100·0 ± 2·0 | 101·4 ± 2·0 | 88·5 ± 1·6 |
| | $A$ | 100·0 ± 5·0 | 75·3 ± 5·6 | 72·0 ± 5·4 |
| Absorption coefficient | $C$ | 100·0 ± 4·5 | 117·8 ± 5·2 | 160·8 ± 5·0 |
| | $B$ | 100·0 ± 7·0 | 123·1 ± 7·0 | 110·6 ± 6·7 |
| 'Number of neutrons' $\left(= \frac{\text{activation}}{\text{abs. coeff.}}\right)$ | $C$ | 100·0 ± 4·7 | 71·1 ± 3·2 | 60·0 ± 2·2 |
| | $B$ | 100·0 ± 7·3 | 82·4 ± 5·0 | 80·1 ± 5·1 |

N.B. Each row has been scaled to make the first figure 100, and figures in different rows are not comparable. The errors shown are the mean square errors due to statistical fluctuations.

Some measurements using ice instead of paraffin wax in the Dewar vessel have given similar results.

It will be seen that groups $A$ and $B$, as well as $C$, are affected by changes of temperature. This is in contradiction with the estimates of the energies of the former groups hitherto accepted[2], which gave values of several electron-volts, compared with the 0·037 e.v. or less corresponding to the temperatures used. For other reasons it appears unlikely that the energies of groups $A$ and $B$ have values lying in the region of thermal equilibrium, but according to our experiments they cannot be greatly in excess of such values. It follows from this that the assumption that the absorption coefficient of boron varies inversely as the velocity of the neutrons must be in error.

We desire to thank Lord Rutherford for putting the facilities of the laboratory at our disposal, and Dr. M. L. Oliphant for helpful discussions. It is hoped to continue experiments on these lines, and a fuller account will be published in due course.

A. ARSENJEWA-HEIL.
O. HEIL.
C. H. WESTCOTT.
Cavendish Laboratory,
Cambridge.
Aug. 10.

[1] *Ric. Scient.*, (ii), **6**, 344 and 443 (1935); (i), **7**, 454 (1936).
[2] Amaldi and Fermi, loc. cit.; Frisch and Placzek, NATURE, **137**, 357 (1936); Weeks, Livingstone and Bethe, *Phys. Rev.*, **49**, 471 (1936).

## Mechanism of Carbohydrate Breakdown in Early Embryonic Development

DURING the past twelve months, we have been engaged in a systematic study of the intermediary mechanisms of carbohydrate breakdown in the chick embryo in the first week of its developmental period. Although we have not yet brought our work to a conclusion, we wish to give an interim summary of it.

Attention has been concentrated throughout on the embryo of 4–6 days' incubation, and the first experiments done were measurements of anaerobic glycolysis with different substrates. It is found that glucose and mannose are the only sugars which give a steady long-continuing glycolysis; disaccharides, even when phosphorylated (such as trehalose-phosphate), and pentoses, are unattacked; as also is fructose. Chemical estimations show that lactic acid is formed quantitatively during glycolysis. Various parts of the embryo separately give the same result as the whole embryo, so that the relatively large proportion of nervous tissue present cannot be held accountable. Addition of inorganic phosphate does not increase the glycolytic rate of glucose or mannose, or cause the breakdown of other sugars. Glycogen is not glycolysed by pulped or minced embryo any more than it is by intact embryos, and even fairly active acetone powders prepared according to the method applied to brain by v. Euler, Gunther and Vestlin[1], will not glycolyse glycogen. With intact embryos, embryo-*Brei* and acetone powders, there is often an induction period of a few minutes in the glycolysis of mannose and glucose; this initial lag may be abolished by the addition of co-zymase or adenyl-pyrophosphate.

The trisaccharide of Levene and Mori[2] (2 mannose plus 1 glucosamine), contained in egg proteins, is not attacked by intact embryos; but when the mannose has been made available by hydrolysis, embryos can glycolyse the product. Probably the yolk-sac

hydrolyses it *in vivo*. Glucosamine itself is not glycolysable, and another trisaccharide, raffinose, is also unattacked.

Chick embryo resembles mammalian brain in that its glycolysis, whether of glucose or mannose, can be almost completely abolished by the addition of glyceraldehyde. The autoglycolysis, however, cannot be inhibited in this way.

Study was also made of the appearance of bisulphite-binding compounds during embryonic glycolysis. By the methods of Clift and Cook[3], it was found that a considerable accumulation of pyruvic acid occurs both ærobically and anærobically. Of the carbohydrate glycolysed, some 60 per cent appears temporarily in the form of pyruvic acid, if no substrate is given, but if glucose is present the relative amount is much reduced (to less than 10 per cent) although more pyruvic acid appears. The accumulation of pyruvic acid occurs in embryo tissues of 10 days incubation also. In view of the work of Peters and his collaborators[4], on avitaminous bird brain, it was conjectured that the embryo might be physiologically $B_1$-deficient, but on the contrary the addition of crystalline vitamin $B_1$ had no effect on the pyruvic acid accumulations.

Next, the rates of anærobic and ærobic glycolysis of the embryo were compared with the rate of oxidative disappearance of lactic acid. In embryo, the Pasteur effect is extremely marked. If Meyerhof's resynthesis theory were the correct explanation of this, the rate of disappearance of added lactate (in the absence of glycolysable substrate) should be equal to the observed difference between ærobic and anærobic glycolysis in the presence of glucose. But in fact it is far less than that. Some explanation of the Pasteur effect in embryo, other than the Meyerhof cycle, must therefore be found.

In this respect, chick embryo resembles mammalian brain (Dixon[5]). The effect of potassium in increasing respiration and anærobic glycolysis observed by Ashford and Dixon[6] was, however, looked for, and found not to exist in the case of embryo. In this respect, it differs from brain.

Another line of attack which we have used is that of analysing the distribution of phosphorus among the various fractions of the aqueous trichloracetic acid extract. Chick embryo differs widely from muscle or brain in that no less than 60 per cent of its water-soluble phosphorus is found in the 'hexosemonophosphate' fraction unprecipitable with barium. This phosphorus-containing material cannot be the Robison ester and is probably not hexose-monophosphate at all, since it is not fermentable by yeast and contains too little phosphorus in the elementary analysis. It is very resistant to acid hydrolysis. Embryo is therefore similar to tumour, where, as Outhouse[7] has shown, a large amount of the same fraction is present, perhaps as hexosamine-phosphate or amino-ethyl-alcohol-phosphate; and with blood where, according to Kerr and Daoud[8], half the whole amount of phosphorus may be in the form of diphosphoglyceric acid.

The distribution of the phosphorus was further investigated after treatment of the embryos at 37° for some time with fluoride in a dosage just sufficient to inhibit glycolysis 90 per cent. The medium contained inorganic phosphate. Contrary to what would be expected if the embryo followed the example of muscle, there was no accumulation of difficultly hydrolysable esters; on the contrary, there was a piling up of inorganic phosphate at the expense of the phosphagen and the adenyl-pyrophosphate. This is not a specific effect of the fluoride, but happens also when the embryos are suspended in Ringer-bicarbonate anærobically without the addition of any substance. Upon the fraction not precipitable by barium, fluoride has no effect; this remains constant. It persists, moreover, in about the same relative proportion until at least the fifteenth day of development.

One of the main points of interest in this work is, of course, the question whether the embryo's carbohydrate breakdown is entirely, partially, or not at all effected by means of a phosphorylation system. At present we only wish to record that apparently neither intact embryo nor embryo-*Brei* will glycolyse any combination of the phosphorus-containing intermediates, for example, sodium glycerophosphate with sodium pyruvate, sodium phospho-pyruvate, or sodium phospho-glycerate. Dihydroxyacetone is not broken down, whether inorganic phosphate is present or not. As we expected from the work of Neuberg, Kobel and Laser[9], methyl-glyoxal is converted to lactic acid at a rate about half that of glucose, which under certain conditions may be increased by added sulphydryl. The embryo will not form lactic acid from hexose-diphosphate, glucose-monophosphate, or mannose-monophosphate. But on the other hand, inactivated embryo-*Brei* forms a dihydroxyacetone-phosphate fraction from added hexose-diphosphate to the same extent as mammalian muscle extract, and forms phospho-glyceric acid from phospho-pyruvic acid. It also transfers phosphorus from phospho-pyruvic acid to adenylic acid (the first part of the Parnas reaction). We hope that our experiments will shortly permit of final decision regarding the question of phosphorylation in the embryo.

JOSEPH NEEDHAM.
W. W. NOWIŃSKI.
R. P. COOK.
KENDAL C. DIXON.

Biochemical Laboratory,
Cambridge.
July 20.

[1] v. Euler, Gunther and Vestlin, *Z. physiol. Chem.*, **240**, 265 (1936).
[2] Levene and Mori, *J. Biol. Chem.*, **84**, 49 (1929).
[3] Clift and Cook, *Biochem. J.*, **26**, 1788 (1932).
[4] Peters *et al.*, *Proc. Roy. Soc.* B, **110**, 431 (1932).
[5] Dixon, *Biochem. J.*, **29**, 973 (1935).
[6] Ashford and Dixon, *Biochem. J.*, **29**, 157 (1935).
[7] Outhouse, *Trans. Roy. Soc. Canada*, v, **29**, 77 (1935); and *Biochem. J.*, **30**, 197 (1936).
[8] Kerr and Daoud, *J. Biol. Chem.*, **109**, 301 (1935).
[9] Neuberg, Kobel and Laser, *Z. Krebsforschung*, **32**, 92 (1930).

## Reliability of Seismograph Stations

IN a recent paper, Dr. H. Jeffreys[1] works out a 'reliability' factor for seismograph stations throughout the world, using information from the International Seismological Summary for 1930 January to 1931 March. Reliability results based on this information do not, however, represent present conditions. Seismology has made rapid headway since 1931, and a number of stations have improved both their recording equipment and their timing.

The characteristic which Jeffreys terms 'reliability' is obtained by expressing the number of $P$ residuals not exceeding $\pm 4$ seconds, as a decimal of the total number of $P$ residuals; so that the 'reliability' values vary between 0·0 and 1·0. A table of such values for each station is given, the stations being grouped into five regions. Of the seventeen stations in the 'Pacific' group, we find Wellington, with readings from two Milne-Shaw seismographs, taking thirteenth place; and Christchurch, with readings from a

single Milne seismograph, taking fifth place. The 'reliability' values given are as follows:

$$\text{Wellington} \quad \frac{8}{24} = 0\cdot3\,;$$

$$\text{Christchurch} \quad \frac{4}{8} = 0\cdot5.$$

This surprising result led me to make a detailed examination of the data for Wellington and Christchurch. Working on the same lines as Jeffreys, and using the same data, I obtained the following values for the 'reliability':

$$\text{Wellington} \quad \frac{11}{27} = 0\cdot4\,;$$

$$\text{Christchurch} \quad \frac{3}{9} = 0\cdot3.$$

The above results differ from those obtained by Jeffreys, but they are more in accordance with the instrumental equipment at the two stations. However, if more recent observations were used, both stations would undoubtedly have higher values.

The $P$ residuals at Wellington are nearly all negative. Of the eleven not exceeding $\pm 4$ seconds, eight are negative, two are zero, and one is positive; giving a mean residual of nearly $-2$ seconds. This suggests that the deviations found for this station are not random errors, and that the station should be classed with those showing systematic errors. These observations giving negative residuals refer to Pacific earthquakes with epicentres to north or north-west of Wellington, and it is possible that these need some readjustment, as there is generally a lack of near stations in eastern azimuths as compared with western azimuths. It seems certain, as suggested by Jeffreys, that sufficient weight has not been given to Wellington and Christchurch in the determination of Pacific epicentres.

In dealing with the utility of his results, Jeffreys selects a number of stations of good 'reliability' for each of the five regions. As 'Pacific' stations, those selected are: Riverview, Palau, Manila, with Melbourne and Adelaide to check Riverview.

This cannot be considered a complete list for years following 1931, since both Wellington and Christchurch would almost certainly be included as stations of good 'reliability'. Also, the standard errors of $P$ should now be less than the value of 4 seconds, which Jeffreys applies to these stations.

R. C. HAYES.
(Acting Director.)

Dominion Observatory,
Wellington,
New Zealand.
July 17.

[1] "A Comparison of Seismological Stations", *Mon. Not. Roy. Ast. Soc., Geophys. Suppl.*, 3, No. 9, 423 (April, 1936).

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I SHOULD agree with Mr. Hayes that not much importance should be attached to the difference between Wellington and Christchurch. The standard error of a reliability $r$ based on $n$ observations is $\sqrt{\{r(1-r)/n\}}$; then with my data the results are Wellington $0\cdot33 \pm 0\cdot10$, Christchurch $0\cdot50 \pm 0\cdot18$. This is for all earthquakes recorded at the stations. For Pacific earthquakes alone, I get Wellington $0\cdot36 \pm 0\cdot13$, Christchurch $0\cdot56 \pm 0\cdot19$. The difference is therefore not more than might be attributed to random sampling. On the other hand, we may notice that there were three times as many readings of $P$ at Wellington as at Christchurch, though in most cases the amplitude of the motion of the ground must have been about the same, and many of the inferior observations at Wellington refer to earthquakes when Christchurch failed to record $P$ at all.

The data as presented in the International Seismological Summary do not indicate the clearness of the movement, and it is probable that the clearer movements at Wellington correspond to a much higher reliability. I also directed attention in my paper to the fact that in some cases too little weight seems to have been given to the near stations in determining the epicentres, and that for this reason the reliabilities found for both stations may be too low for earthquakes in the South Pacific; but to remove this error would mean recalculating the whole of the epicentres.

Support can be found for the higher reliability of Wellington in strong or fairly near earthquakes from the residuals at the British stations with Milne-Shaw instruments in the series of deep-focus earthquakes that I have discussed recently[1]. Oxford is excluded because it has already been found to have a high reliability. The residuals for the others together have the following distribution:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Residual (seconds) | −2 | −1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Number | 2 | 2 | 6 | 2 | 2 | 1 | 0 | 1 | 1 | 0 | 1. |

These correspond to a mean reliability of $15/18 = 0\cdot83 \pm 0\cdot09$; but the mean for these stations for general work was only $0\cdot50 \pm 0\cdot08$.

The results in my paper do not place the stations in a definite order of merit, since the sampling error is appreciable; but they serve to indicate approximate weights to use in the determination of epicentres. I should recommend using for Wellington, when within 30°, the weights for reliability 0·6 until further information is available.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

[1] *Mon. Not. Roy. Ast. Soc., Geophys. Suppl.*, 3, 310 (1935).

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## "A Treatment of Modern Physics"

UNDER the above title, E. N. da C. A., in NATURE of June 13, has subjected my co-worker, Mr. N. K. Saha and myself, to a vigorous 'strafing' for writing "A Treatise on Modern Physics", Vol. 1, published by the Indian Press of Calcutta and Allahabad. In fairness to the large number of readers (not merely Indian) who, between the publication of the book in November, 1934, and its review in NATURE, have wasted, according to the reviewer, thirty shillings on a book advocating a "method of teaching" which he holds "to be pernicious", I, as the senior author, seek permission to publish the following apologia in NATURE.

Reviewers have their own right, which I do not propose to question, but they are expected to give a short *résumé* of the subject matter of the book, point out mistakes or misstatements of facts, find out possible errors in the presentation of current ideas and to deal with important omissions, as has been done in NATURE by Prof. R. H. Fowler in a review of another work by me. In no case have we come across a review in which the reviewer finds faults with the author for not including matter which is expressly stated to be reserved for subsequent treatment.

In the present case, the reviewer has followed an *original line in his review. He does not give a résumé*, does not point out a single mistake, and does not say that the presentation of ideas has been marked by any serious error or bad style. He deals only with *omissions*, in spite of the fact that the authors themselves noted these omissions in the following passage which occurs in the preface :

"It was first intended to include chapters on Molecular Physics, interaction between matter and light, wave-mechanics and Nuclear Physics, but as the book has already become bulky, it was decided to incorporate those chapters in a second volume."

Most of the omissions to which the reviewer devotes three-quarters of his criticism, namely, failure to give an account of the correspondence principles, selection rules, principles of wave-mechanics and also some advances on positive rays fall under the chapters mentioned above. The reviewer's remarks regarding the omissions are, therefore, not only irrelevant but also extremely ungracious to the authors.

As to the other minor charges—omission in Chapter iii (Positive Rays) of mention of Aston's and Bainbridge's precision mass-spectrograph and of the results obtained therefrom—the explanation is very simple. The present volume, being confined solely to discussion of atomic structure, the authors were justified in omitting all references to such works, which have a bearing on nuclear physics. This has been expressly mentioned on page 99. Further, at the time of writing, Aston and others (Rutherford, Oliphant, Kempton, Bethe) were engaged in revising the mass-scale. The authors did not, therefore, feel justified in including such matter as would become obsolete before the ink had dried. Probably if the results had been included, the reviewer would have found fault for their inclusion.

Regarding the chapter on magnetism, the authors were aware of the current theories of ferromagnetism, but on perusal of these had come to the conclusion that these theories were only 'phenomenological' and had better be omitted from a text-book. The wisdom of such a step was justified in Simon's recent discovery that, near the absolute zero, all paramagnetic substances tend to become ferromagnetic. This probably necessitates a revision of the current theories of ferromagnetism, which trace it to exchange resonance amongst the $d$-electrons of the transitional elements of the first group. I do not think that such matter as magneto-caloric effect or of magnetostriction need be incorporated in a book dealing mainly with atoms. It is possible to have legitimate differences of opinion on this question.

The reviewer complains that there has been too much of complex spectra in this treatise. In this connexion the following passage in his well-known text-book published in 1927 ("The Structure of the Atom") may be quoted :

"A discussion at Danzig in September, 1925, between some of the most celebrated workers in the field of quantum analysis of spectra, at which the writer had the pleasure of being present, foundered, if the expression may be used, on the question of notation, none of the speakers being able to understand the notation of the others and each having also apparently difficulties with his own."—(Footnote, p. 569.)

In spite of this situation nine years ago, the writer of this text-book, who according to his own admission did not at the time understand the subject, devoted 79 pages of his text-book to multiplet structure. The reviewer admits that the difficulties of a lucid exposition of the subject of complex spectra have largely disappeared as a result of advance of knowledge within the last ten years, but he puts forward the very curious view that the necessity of giving a full exposition of the subject, in the circumstances, no longer remains.

It is rather difficult to understand the reviewer's remarks about the inner quantum number and the spinning electrons. The writer's point of view has been the approach of the subject from the side of spectroscopy, while the reviewer would like to develop it from the mechanical side. The two views being divergent, the criticisms are rather ungracious. In one case he has misrepresented the actual language used about the rotating electron. I may add that Goudsmit and Uhlenbeck used the term "Rotierende Elektron". He writes "the perephral velocity is even worked out on these lines and the absurd value which results is said to be unexplained". The mathematical results, for quoting which fault is found, have been taken from Goudsmit and Uhlenbeck's original note to *Die Naturwissenschaften*, and the words used by these authors are as follows : "The linear velocity at the periphery of the electron thus comes out to about 308 times the velocity of light, a deduction which has still to remain *incomprehensible*."

The authors at any rate may be expected to know the methods of teaching, pernicious or otherwise, which prevail in India, and they do not propose to bother about the *ex cathedra* remarks of the reviewer on this question.

M. N. SAHA.

IT is now more years than I care to think of since books were entrusted to me for review in NATURE, but it is the first time that I have seen a letter anything like that which Prof. Saha has sent for publication, and in the original and longer form in which the Editor showed it to me it was even more individual. I can scarcely be expected, at this time of day, to take lessons from Prof. Saha as to how to review a book, or to deal with his letter point by point, especially as a great deal of it is, to speak mildly, disingenuous. I may remark, however, that it is not correct to say that I did not point out a single mistake, and, further, that I was less concerned with details than with general principles. It was owing to a delicacy which I now realize to have been misplaced that I did not remark on the style in which the book is set down. Perhaps Prof. Saha's letter furnishes comment on that point.

My criticism was mainly directed to the fact that the book contains masses of detail, much of it unnecessary and some of it out of date, omits matters of prime importance for the subject under discussion, and provides little or no explanation of the principles on which the complicated calculations printed in the book are based. I have made my point of view perfectly clear, as I am entitled to do, and have not misrepresented that of the authors, and, in my experience, misrepresentation and ambiguity are the sole grounds which are held to justify a reply to a review. Those who hold that the points raised are trivial will set me down as mistaken, as in the case of the spinning electron, where all the relevant matter is before the reader.

What I gather to be the point of Prof. Saha's present communication is, first, that all the missing matter which one might have expected to find in this book—

some description of the method of anode rays and of the work of Bainbridge in the chapter headed "Positive Rays"; some explanation of the general methods of quantization before, for example, fourteen pages are devoted to the calculations on the Stark effect; some mention of the work of Hartree and others where the old work on electron distribution is discussed; and, in short, all the other fundamental points which, as I point out in my review, are completely neglected—is going to be described in a second volume; and secondly, that I ought to have known this from the passage which he quotes from the preface. The answer is, first, that the passage which he quotes does not say this, and, secondly, that even if it did, this is, *in my opinion*, a bad way of writing a book, especially as Prof. Saha's disciples are still awaiting the second volume which shall explain the first. In my opinion—but Prof. Saha says that my opinion is not worth much. For all I know he may be right, but there his quarrel is with the Editor, who invited me to give it, and not with me. In any event, Prof. Saha's remark that the authors "do not propose to bother about the *ex cathedra* remarks of the reviewer" on methods of teaching absolves me from the distasteful task of spending further time on Prof. Saha's favourable review of this volume of his book. I look forward, however, to reading his review of the second volume.

E. N. DA C. ANDRADE.

## 'Lines' on the Surface of Moving Water

SINCE reading the interesting accounts of this phenomenon by Prof. W. Schmidt[1] and Prof. H. Stansfield[2], I have noticed several striking instances which yield a clue to their cause. They occurred on the surfaces of clear country streams bridged by planks that touched the water, obstructions which, mechanically, resemble the mill-stream example described by Prof. Stansfield. Evidently the macroscopic agent causing the sudden change in velocity need penetrate only to a very small depth.

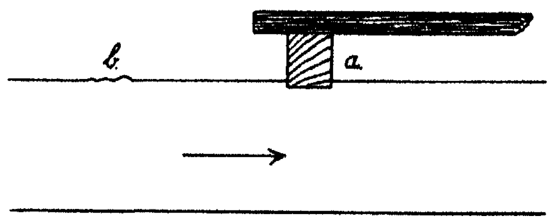



FIG. 1. Schematic diagram of stream (vertical longitudinal section); *a*, beam penetrating surface; *b*, surface line and secondary waves.

In the case illustrated, the 'line' was remarkably stable at an average distance of about 40 cm. from the bridge, and the conditions such as to be easily reproducible in a laboratory. The stream was about 1·3 m. wide and 40 cm. deep. The water flowed without visible turbulence and with a mid-stream surface velocity of about 25 cm. per sec. Fig. 1 represents a vertical, longitudinal section of the stream and foot-bridge, which touched its surface across the full width. Close to the line on the up-stream side was a series of parallel waves of diminishing amplitude and stationary with respect to the line. These secondary waves are clearly visible in the photograph (Fig. 2), and the reflections of over-hanging foliage demonstrate the relative tranquillity of the surface between the line and the obstruction causing it.

In a wider and more slowly moving portion of the stream, a similar bridge had collected a band of scum. Here the line occurred nearly a metre above the scum, and secondary waves were visible only when the line was disturbed by winds, to which it was more sensitive than the line photographed.

FIG. 2. Photograph of a particularly stable 'line'.

The experiments recorded in previous letters concerning the behaviour of floating particles and the effect of soap were repeated. The initial position of the line depends on the velocity of the stream, whilst the extent of its temporary displacement up-stream caused by substances affecting the surface tension depends on the velocity of the stream, and on whether the addition is made up-stream or down-stream relative to the line. Qualitatively, the observations, including the 'oil-patch' effect, are consistent with the idea that the line marks the boundary of a surface film of colloidally dispersed material under lateral compression caused by movement of the water.

R. O. HALL.

2 Gwendolen Avenue,
Putney, S.W.15.

[1] NATURE, 137, 777 (1936).
[2] NATURE, 137, 1073 (1936).

## Habit and Shell-shape in the Portuguese Oyster, *Ostrea angulata*

IT is known that the form of the shell of Portuguese oysters (*O. angulata*) living on the shore is different from that of individuals living permanently below tide-marks[1]. In the latter the shell is relatively very broad, in the former long and narrow, almost in the shape of a shoe-horn with the hinge at the narrow end. No explanation of this difference in shape could formerly be offered, but in a recent inspection of extensive inter-tidal beds of Portuguese oysters in the River Blackwater, to which I was courteously invited by Mr. Louis French, a probable explanation of the prevailing elongate-shaped shell suggested itself.

The oysters were lying on the normal muddy bed and had recently put on extensive new shell growth which was concentrated mainly at the end of the shell remote from the hinge; in almost all cases, the new growth was turned up from the substratum, whichever way the oyster was lying, so that in crossing the beds one walked on the sharp protruding shell-edges. As increments in shell-area are laid

down by the mantle, this organ must be protruded mainly at the end of the shell, at least during growth, in a foreshore habitat. It seems probable that on the usual muddy foreshore bed the mantle is normally extended upwards in this part for feeding and respiration. Such a habit would give the advantage of an intake of clearer or less muddy water than is available around the more anterior edges of the shell which lie more or less in the mud, while if muddy water is inhaled the particles of foreign matter can readily be got rid of from a restricted region. If the normal habit is to extrude the mantle from the broad end of the shell as stated above, then it would follow that shell would be laid down with the mantle extended in this way and an elongate form of shell results. The sensory equipment of the bivalve is doubtless adequate to determine the most suitable region for intake of water.

On the other hand, in deep water where broad shells were found, the beds tend to be less muddy and the direction of the currents of water more regular; it is therefore reasonable to suppose that there is less need for restriction of the mantle opening in this habitat, and that the mantle will normally be more uniformly extended. In that event, new growth will not be concentrated at the broad end of the shell and a broader shell will result.

It seems, therefore, that a difference in habit of controlling the extension of the mantle in the two habitats may account for the difference in the shape of the shell. At least two factors appear to be concerned, namely, the nature of the substratum, and the simplicity or complexity of the water-currents in the respective habitats. Further researches on shell-shape of this and *O. virginica*, the allied American species, living on different types of substratum below low water, would be interesting; for the American species resembles the Portuguese form to a considerable extent in habitat and shell-modifications[2].

The variable sinuous or irregularly twisted elongate form of the shell seen more commonly in the cultivated Portuguese oyster is clearly due to the habit of adding large new shell-shoots mainly from the upturned broader end.

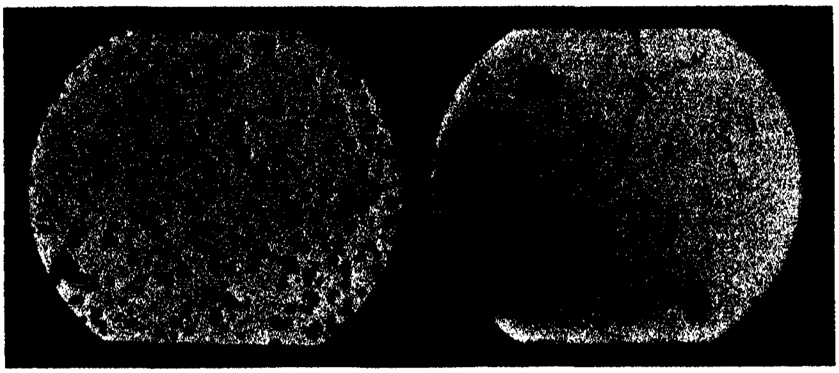
J. H. ORTON.

Department of Zoology,
University, Liverpool.
Aug. 14.

[1] J. H. Orton and P. R. Awati, *J. Mar. Biol. Assoc.*, **14**, 227 (1926).
[2] Dean Bashford, *Bull. U.S.F.C.*, **10**, 367, 1890 (1892).

## Life in the Dead Sea

THE remarkably high salt tolerance of unicellular organisms, which have been found in a saline lake of salt concentration so high as 19–26 per cent sodium chloride by Ruben Tschik, T. Hof, Baas-Becking and others, caused us to doubt the accuracy of the reputation of lifelessness, which tradition imputes to the Dead Sea. Accordingly, samples of Dead Sea water were taken under sterile conditions at a distance of 3–4 km. from the mouth of the Jordan at various sea depths up to 7 metres. The total salt concentration of the water samples was 28–29 per cent. Bacterial organisms could be grown in 1 per cent peptone sample water media at temperatures of 21°–23° C. and 30° C. from all the samples taken.



a b

FIG. 1. Dead Sea micro-organisms. × 550.

In addition, microscopic examination of a hanging drop of the water revealed the presence of a living phytoflagellate 13μ long, which we believe is either a *Chlamydomonas* or a *Dunaliella*. Three micro-organisms have so far been distinguished: a yeast-like, Gram negative orange pigment producer $1 \cdot 6 \times 1 \cdot 6\mu$ (Fig. 1*a*), a Gram negative small rod-like organism $1 – 4 \cdot 8\mu \times 0 \cdot 8\mu$, and a Gram positive long filamentous organism (Fig. 1*b*) $3 \cdot 3 – 9 \cdot 9\mu$ to $170\mu \times 0 \cdot 8\mu$. The investigations are being continued.

We take this opportunity of expressing our thanks to Mr. M. A. Novomeysky, managing director of the Palestine Potash Co. Ltd., for his most kind assistance.

B. WILKANSKY.

Department of Hygiene and Bacteriology,
Hebrew University,
Jerusalem.

## A New Blowfly attacking Sheep in Western Scotland

IT is now generally accepted that *Lucilia sericata* is the only species of blowfly which causes primary 'strike' of sheep in Britain. Although MacDougall (1909)[1] recorded instances of sheep being struck by *Calliphora erythrocephala* alone, the more recent investigations of Davies (1934)[2] in Wales, and of Ratcliffe (1935)[3] in Aberdeenshire, failed to reveal any primary species other than *Lucilia sericata*. The following record is, therefore, of interest.

In the course of an investigation of the blowfly problem, I have obtained, from Mull and western Argyllshire, several collections of larvæ taken from field cases of strike. The larvæ were in each case transferred directly from the sheep into metal containers filled with a sand-sawdust mixture. On arrival they were placed in breeding jars, of a type which prevented the possibility of contamination of the cultures by ovipositing flies. Out of thirteen batches bred out to the adult stage, seven were found to be pure collections of *Phormia terræ-novæ R.-D.*

I am indebted to the Natural History Museum for the identification of the species from specimens submitted. The batches were all obtained from blackfaced sheep in long wool; the strikes occurred on various parts of the body, for example, the throat, loins, tailhead, breech, etc. Each batch yielded anything from a dozen or so to more than three hundred individuals.

It would appear, therefore, that in western Scotland at least, this species acts as a primary blowfly, initiating strike on relatively clean-woolled areas.

The closely related species, *Phormia regina*, is the principal sheep blowfly of North America, but *Phormia terræ-novæ* has not been recorded previously, from any country, as attacking sheep. In view of its wide European and North American distribution, and of the newly emerged fact that it is able to strike sheep, the absence of any such records is a matter of considerable interest.

JOHN MACLEOD.

The Cooper Technical Bureau,
47 Russell Square,
London, W.C.1.
Aug. 21.

[1] MacDougall, R. S., *Trans. Highl. Agric. Soc. Scot.*, **21**, 135 (1909).
[2] Davies, W. Maldwyn, *Ann. App. Biol.*, **21**, 267 (1934).
[3] Ratcliffe, F. N., *Ann. App. Biol.*, **22**, 742 (1935).

## Temperature Coefficient of the Electrolytic Separation of the Hydrogen Isotopes

IN the course of an experimental study of the electrolytic separation of the isotopes of hydrogen at current densities of one milliamp./cm.[2] and less with rigorous exclusion of oxygen, grease and other contamination, we have measured the temperature variation of the separation at mercury and silver cathodes with somewhat unexpected results.

The electrolyte was 0·5$N$ hydrogen chloride (with 0·5$N$ potassium chloride added in the experiments with mercury), and the anode consisted of the same metal as the cathode. The deuterium content of the cathode gas was determined by the micro-thermal conductivity method of Farkas[1]. The following values for the electrolytic separation coefficient ($\alpha$) were obtained at 15° C. and 98° C.:

| Cathode | 15° C. (i) | 15° C. (ii) | 98° | 98° (calc.) |
|---|---|---|---|---|
| Mercury | 2·8 | 3·35 | 3·25 | 2·3 |
| | 3·1 | 3·25 | 2·95 | 2·5 |
| Silver | 7·0 | 6·5 | 4·6 | 4·6 |
| | 7·0 | 6·6 | 4·4 | 4·6 |

The two columns for the lower temperature relate to measurements made respectively before and after the high temperature measurements. The last column gives the separation factor that would be expected at 98° C. from the relation

$$\ln \alpha = \frac{\Delta E}{RT},$$

where $\Delta E$ is the difference in activation energy necessary to account for the separation factor (i) at 15° C. The probable error in the values of $\alpha$ is 2–3 per cent. The anomalous behaviour of mercury is remarkable, but might perhaps be accounted for by assuming that both of the alternative mechanisms ('catalytic' and 'electrochemical') of Horiuti and Okamoto[2] contributed to the cationic discharge, and that at the higher temperature the relative participation of the two mechanisms became more nearly equal.

With the view of testing this possibility, small quantities of $\alpha$-naphthoquinoline, which might be expected to inhibit the 'catalytic' mechanism, were added to the electrolyte with the following results:

| Cathode | Concentration of inhibitor | 15° (i) | 15° (ii) | 98° |
|---|---|---|---|---|
| Mercury | 2 millimols/litre | 1·25 | 1·4 | 1·7 |
| | 0·3 ,, ,, | 1·55 | 1·55 | 2·2 |
| Silver | 0·3 ,, ,, | 1·7 | 3·0 falling to 2·3 | 3·7 |

The results for mercury, which incidentally show the lowest separation yet recorded, do not seem to fit in with the provisional hypothesis outlined above. The possibility that isotopic discrimination in cathodic reduction of the catalytic poison would account for the anomalous temperature variation seems to be excluded by the duration of the electrolysis.

The experiments are being continued and their possible interpretation will be discussed in detail elsewhere.

H. F. WALTON.
J. H. WOLFENDEN.

Balliol College and Trinity
College Laboratory,
Oxford.
August 8.

[1] A. and L. Farkas, *Proc. Roy. Soc.*, A, **144**, 467 (1934).
[2] Horiuti and Okamoto, *Sci. Papers Inst. Phys. Chem. Research, Tokyo*, **28**, 231 (1936); *Brit. Chem. Abstracts*, 430 (1936).

## Raman Spectrum of Thiophosphoryl Chloride

THE Raman spectrum of phosphorus oxychloride has been explained by assuming an asymmetric tetrahedral structure for its molecules. The molecules of thiophosphoryl chloride may, by analogy with those of the oxychloride, be supposed to have a similar tetrahedral structure; and the Raman spectra of these two compounds should then be similar.

The following table gives the prominent shifts that I have observed in the Raman spectrum of thiophosphoryl chloride:

| | $PSCl_3$ | $POCl_3$[1] |
|---|---|---|
| $A$ | 171 cm.$^{-1}$ | 192·85 cm.$^{-1}$ |
| $B_1$ | 246 ,, | 267·39 ,, |
| $B_2$ | 382 ,, | 337·44 ,, |
| $C$ | 432 ,, | 486·24 ,, |
| $D_1$ | 543 ,, | 581·2 ,, |
| $D_2$ | 750 ,, | 1280·9 ,, |

The data for the oxychloride are taken from Langseth's work[1]. The slight reduction in the values of the Raman shifts in thiophosphoryl chloride is presumably due to the substitution of the oxygen atom in the oxychloride by an atom of sulphur.

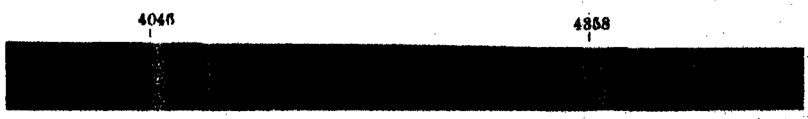



FIG. 1. Raman spectra of thiophosphoryl chloride ($PSCl_3$).

The shift $\Delta\nu$ = 1,290 has been assigned to the P—O bond in the oxychloride[2]; the shift $\Delta\nu$ = 750

in thiophosphoryl chloride can then be assigned to the P—S bond. The shifts $\Delta\nu = 171$; 246; 432 are very strong and the corresponding anti-Stokes lines excited by $\lambda = 4046$ can be seen in the spectrum.

A further study of the Raman spectrum of these two compounds as regards polarization and structure of the Raman lines is in progress, and the results of these studies will be published elsewhere.

V. N. THATTE.

College of Science,
Nagpur.
July 28.

[1] Langseth, *Z. Phys.*, **70**, 350 (1936).
[2] Venkateswaran, *Ind. J. Phys.*, **6**, 275 (1931).

## Scientists and War

AT a meeting of prominent scientists held at Bangalore on August 22, under the joint auspices of the Institute of Chemistry of Great Britain and Ireland (Bangalore Branch) and the Society of Biological Chemists (India), to discuss the question of the moral responsibility of scientists in modern warfare, which has recently attracted much attention in these columns[1] and elsewhere, the following resolution was carried:

"This meeting while pledging its support to every united effort which can be made to abolish methods of warfare which are repugnant to the common instinct of humanity, recognizes that the more important objective is the abolition of war itself. To attain this end it would urge constant and strenuous activity on the part of thinkers and men of science. In particular, it records its opinion that more attention should be given by them to the study of the new economic conditions which of necessity accompany the advance of scientific research. Of equal or greater *importance is the study of means for controlling the* evil effects of mass suggestion by the more powerful agency of widely disseminated right ideas through the adoption of an international system of education."

C. N. ACHARYA.

Bangalore.
August 23.

[1] NATURE, **137**, 757 (1936); **137**, 829 (1936); **138**, 80 (1936); *J. Inst. Chem.*, Pts. 1 and 2 (1935).

## Points from Foregoing Letters

FURTHER experiments on the production of photoelectrons in argon gas by X-rays, carried out by Dr. E. J. Williams and E. Pickup, support the quantum theory and the principle of conservation of energy, the applicability of which to X-radiation processes had been disputed, following upon the results of Shankland's experiments.

The radioactivity induced in silver at 20°, 77° and 290° K. by slow neutrons of different energies (groups *A*, *B*, and *C* of Amaldi and Fermi) has been determined by Drs. A. Arsenjewa-Heil, O. Heil and C. H. Westcott. They are led to conclude that the energies of groups *A* and *B* must be much lower than had been supposed, and that the absorption of boron is not inversely as the velocity of the neutrons.

The changes which sugar-like substances undergo in, or under the influence of, chick embryos of 4–6 days' incubation have been studied by Dr. J. Needham, W. W. Nowiński, R. P. Cook and K. C. Dixon, and compared with those effected by brain and muscle tissues. They find that the embryo does not glycolyse phosphorus-containing intermediate compounds; that glucose and mannose are the only sugars which give steady, long-continuing glycolysis; that the Pasteur effect is extremely marked; that the phosphorus distribution in various fractions is different from that obtained with muscle and brain preparations.

Referring to the reliability of different earthquake-registering stations deduced by Dr. H. Jeffreys, R. C. Hayes recalculates the values for the Pacific stations at Wellington and Christchurch; he finds that Wellington has a slightly greater reliability factor and considers that, in view of recent improvements, both stations should be included among those of good reliability. Dr. Jeffreys agrees that the order of reliability of Christchurch and Wellington stations cannot be definitely determined owing to the probable error involved in the calculations; he recommends that, for the time being, a 'weight' of 0·6 be accepted for Wellington observations.

Profs. W. Schmidt and H. Stansfield have described instances of the capillary wave that often appears when flowing water encounters an obstacle. Further observations are recorded by Dr. R. O. Hall, who suggests that the line marks the boundary of a compressed surface film of colloidal matter.

The difference in the shape of the shell of the Portuguese oyster, *O. angulata*, living on the shore, as compared with that of oysters permanently below tide-marks, is accounted for by Prof. J. H. Orton in terms of the surroundings. In deeper and less muddy water, the 'mantle' of the oyster, which secretes the shell, is uniformly extended and produces a broad shell; in the muddier tidal water of the foreshore, the mantle is probably protruded mainly at the end of the shell and an elongated form results.

Photographs of micro-organisms (three bacteria and a phytoflagellate) from the Dead Sea, where the total salt concentration is 28–29 per cent, are submitted by Dr. B. Wilkansky.

Dr. John MacLeod records *Phormia terræ-novæ R.-D.* as a hitherto unsuspected agent in the causation of cutaneous myiasis (attack on the skin by larvæ of flies) in sheep in Scotland (western Argyll and Mull).

H. F. Walton and J. H. Wolfenden have measured the temperature variation of the electrolytic separation of the hydrogen isotopes at mercury and silver cathodes, and find that the separation coefficient at silver falls with rising temperature while that at mercury is almost unaltered. Addition of a catalyst poison lowers the separation coefficient considerably and alters the sign of its temperature coefficient.

A reduction in the values of the shifts in the Raman spectrum of thiophosphoryl chloride, $PSCl_3$, as compared with phosphorus oxychloride, $POCl_3$, is found by Prof. V. N. Thatte.

# Research Items

### Blood Group Investigation

RECENT advances in blood group investigation have been reviewed by Prof. R. Ruggles Gates as a contribution to a volume commemorating the work of Miss van Herwerd on blood groups and eugenics in Holland (*Genetica*, 18, 1936. Manuscript received for publication, May 29, 1935). All the evidence indicates that in man the blood groups are mutations forming the mechanism of species modification of the non-adaptive category. The distribution of the blood groups in the anthropoids, when compared with that in man, on the hypothesis that *O* is the primitive condition in man, suggests that the development of the blood groups in both must be regarded as a case of 'convergent evolution'. It seems probable that a particular race in man in a particular locality developed the ability to produce the *A* mutation with sufficient frequency for it to spread without the aid of selection, but through a change in the mutation rate, which would be either gradual or marked and decisive, probably the latter. Recent developments have strengthened the view that the *A* mutation is much older than *B*, of which the occurrence is so low in peripheral peoples as to suggest that it is due to interbreeding with adjacent peoples. This view increases the difficulty relating to the *O* character of the American Indians, unless it be held that they are derived from primitive peoples who were isolated on the chain of islands from Sakhalin to Formosa and the Philippines, while *A* and *B* were spreading on the mainland of Asia. The aboriginal tribes of Formosa are still strikingly high in *O*. The occurrence of a high percentage of *A* in a group of "Blackfeet" can only be accounted for as an independent island of *A* mutations; and the *B* of the Caraja Indians and the Yahgans of Tierra del Fuego must be accounted for in the same way. Recent investigations in Africa suggest the probability that there have been three independent centres of *B* mutation, namely, the African negro, the Hindu and the Mongolian.

### Arminghall Timber Monument

THE prehistoric monument at Arminghall, near Norwich, discovered by aerial photography in 1929, and excavated by Dr. J. G. D. Clark immediately before the Norwich meeting of the British Association last year, proves, like "Woodhenge" in Wiltshire, excavated by Mrs. M. E. Cunnington, to have been a circle in which the place of stone uprights was taken by wooden posts. The character of the monument in detail, its purpose, dating, and affinities, have now been made the subject of close study by the excavator (*Proc. Prehist. Soc.*, N.S. 2, 1; 1936). The monument consists of two concentric ditches separated by a bank, and surrounding a central portion, in which had been erected eight wooden uprights in U-shaped formation, and approached by a causeway interrupting the inner ditch. In this central area there was no sign of disturbance, excepting the post-holes and the ramps, by means of which the posts had been erected. The size and depth of the post-holes and the size of the ramps indicate that the posts were of considerable height—oaks, as shown by the charcoal found in the holes, probably of about a hundred years old. The absence of any burial precluded the idea that the purpose of the monument was sepulchral. The primary material obtained from the inner ditch consisted of 107 flints of indeterminate age, and fragments of hand-made 'rusticated' pottery, that is, pottery decorated with pinches or jabs, of a type to which the specific name 'Arminghall' is here given. On archæological evidence, this pottery is shown to date the monument as belonging to the Beaker period, as do other 'henges' in Britain which so far have been satisfactorily dated. Two hypotheses as to the origin of this class of monument are current—one that they are derived from the palisade barrows of the Low Countries, the other that they are degenerate megalithic cairns; but at present there is no decisive argument in favour of either.

### Coloration of Nest Linings and Nestlings

DR. JEAN M. LINSDALE has noted a correspondence between the colour and tint of the linings of birds' nests and of the down of the nestlings themselves, especially in the Great Basin of the western United States. Further, these are both correlated with the kind of cover at the nest side and with the general climatic ranges of the birds (*Condor*, 38, 111; 1936). Apparently these species of birds which nest in exposed situations and live in hot regions have pallid nestling plumages and nest linings which reflect and counteract the harmful effect of the sun's rays. Species which live in the opposite conditions have dark colours in down and nest, so that they are able to absorb and take advantage of the warmth of the sun's rays.

### Habits of American Sunfishes

THE American sunfishes excavate nests in shallow places, usually on sandy shores, which are familiar objects in late spring and early summer. Mr. C. M. Breder in his paper "The Reproductive Habits of the North American Sunfishes (Family Centrarchidæ)" (*Zoologica*. Scientific Contributions of the New York Zoological Society. Part I, Nos. 1 and 2, 21, 1936) brings a large amount of material together with special reference to reproductive behaviour of these fishes, which is closely similar in all genera. The male constructs the nest and guards the eggs. The female is only concerned with their deposition, her behaviour being very characteristic as she approaches the nest when sex recognition takes place. The primitive forms make the most elaborate nests, and there is more parental care in these than in the higher forms, the nests of which are much simpler. Broadly speaking, the annual cycle of habit in the family shows an interesting series of items of behaviour largely controlled by temperature, and the position and form of the nest depend on a variety of purely physical factors in the environment which include temperature, sunshine, depth of water, rate of flow, nature of bottom and proximity of protecting objects. This is a very interesting study embracing much previous work as well as a great deal of first-hand information.

### The Chordate Head

THE problem of the constitution of the head region in the Chordates is discussed in a fully illustrated article by de Lange (*J. Anat.*, July 1936) based upon three lectures delivered at King's College, London. The vertebrate embryo is regarded as consisting of two portions: a non-metameric part, the gut, splanchnopleura, ventral body wall, brain region and the anterior cephalic mesoderm, arising in a similar manner to the three-layered, unsegmented larva of the invertebrates; and a dorsal, more or less segmented portion, the episome, having no homologue in invertebrates. The episome is pushed in a caudal direction in the Urochordata, in an anterior direction in the Cephalochordata, and in the true vertebrates it penetrates into the posterior part of the head region. This superimposed, axial episome has arisen and become segmented in conjunction with the need for locomotor efficiency. The axial musculature spreads over the trunk and into the head region. The branchial mechanism is afterwards formed, but it is in no way dependent upon the original metamerism of the episoma. As the head constitutes a structure for the gathering of sense organs, for presenting a firm front to the resistance of the water during locomotion and as a base from which the undulatory locomotor movements can take origin, its episomatic constituents lose their segmental structure. Some evidences of it remain, however, in the histological and functional character of the musculature. The hypobranchial muscles retain the metameric character of the invading episomatic mesomeres and of their cranial nerves.

### A New Type of Apospory in Ferns

MISSES I. ANDERSSON-KOTTÖ and A. E. Gairdner (*J. Genetics*, 32, No. 2), investigating the inheritance of apospory in the hart's tongue fern, describe a form known as *peculiar* which arose from spores of the variety *crispum muricatum*. This peculiar type of sporophyte only attains a height of 8 cm. and may bear twenty-five fronds at one time. There is a complete absence of sori, sporangia and spores, the fronds producing aposporous prothalli which bear sex organs and undergo fertilization. As there is no meiosis, the chromosome number increases from $n = 30$ (normal) to a maximum of about 110. Various lines of evidence indicate that the chromosome number is frequently diminished in some way at the formation of the sex organs, but no cytological indication has yet been found as to how this takes place. In crosses between peculiar and normal, the former type of life-cycle is shown to be controlled by a single recessive gene. Heterozygous sporophytes are thus normal in appearance, but they sometimes show a feature which is new in ferns, namely, sori containing some normal sporangia and others which produce spermatozoids. The heterozygotes thus show incomplete dominance as regards the time of sex differentiation, which takes place both in sporangia and in the gametophytes. The conclusion is reached that the sporangial stage in normals is represented by the sexual stage in peculiars, and that a reduction division is therefore attempted at the sexual stage in the peculiar. These results have a bearing on various questions of apogamy, apospory and life-cycles in plants.

### Properties of Oak

No. 11 of *Research Records* (Timber Series No. 3) contains a pamphlet on "The Properties of Home-grown Oak" (London: H.M. Stationery Office, 1936). It is stated in the pamphlet that in the past there has been much difference of opinion as to the merits of the timber, and this is largely attributable to its properties varying considerably with the conditions under which the trees are grown. The writer of the pamphlet appears to consider that there is little difference between the timber of the pedunculate and sessile oaks. By the purely practical test of felling and conversion in the forest, many hold the opinion that the timber of the sessile oak is more easily workable than that of the pedunculate. During the Napoleonic Wars, the finer lines of the French ships captured and the more artistic nature of their fittings were attributed to their having been constructed of the sessile oak, whereas the English ships were most usually constructed of the pedunculate or robur oak, a more stubborn and rugged grower. The pamphlet deals with the general properties and structure of the wood, seasoning, mechanical properties, durability and working qualities. A comparison of home-grown oak and American oak is made, and insect and fungus pests are discussed.

### Inheritance in Cotton

INHERITANCE of form and size play a large part in the improvement of commercial cottons. Dr. J. B. Hutchinson (*J. Genetics*, 32, No. 3) has summarized some of these results. He finds in Asiatic cottons a series of five multiple allelomorphs affecting leaf shape. Broad, laciniated and narrow leaf types occur in *Gossypium arboreum* in different crops, narrow leaf being absent from South India and rare in Burma; it occurs in Assam. Leaf shape is associated with corolla colour. Broad leaf is primitive, and two allelomorphic genes have arisen causing progressive narrowing of the leaf lobes. Both are widely distributed in the species, and in some circumstances one of them has a selective advantage over the broad. Another set of genes affects all foliar organs and not merely the leaves. The habit of the plants is determined by the length of the vegetative period, that is, the number of nodes on the main stem. This is followed by the formation of sympodia with a flower at every node. Wild cottons have a high primary node number, with late flowering. Interaction is indicated for various node number factors, some of which are linked with corolla colour and some with anthocyanin production.

### Carolina 'Bays'

THE 'bays' of the Carolina coastal plain are great oval depressions, usually well-timbered, each of which is rimmedwith a sand-ridge that is highest on the south-east side. Their peculiar and uniform shape, the prevalent orientation of their longest axes in a north-west to south-east direction, and the immense number of examples, suggested to Melton and Schriever that the bays had been caused by the fall of an immense shower of meteorites, during or possibly before the Pleistocene. In a recent issue of *Science*, Prof. D. Johnson has pointed out several objections to this hypothesis. The rims of the 'bays' are not composed of material thrown out of the bottoms by explosive impact, but consist of clean sand, such as might border a lake-beach. The major

axes of some of the depressions follow a north to south direction, and at least a few trend from north-east to south-west. Such departures from the prevailing orientation are inconsistent with the meteoritic hypothesis. The area is underlain by thick beds of limestone in which caverns and sink-holes are common. Johnson considers that the 'bays' started as lakes in sink-hole basins; these afterwards drained, leaving their old beach-ridges where the prevailing winds had piled them. A book on the 'bays' from the pen of Prof. Johnson is in course of publication.

### The British Earthquake of April 6, 1580

LITTLE has so far been known about this earthquake, one of the strongest ever felt in Great Britain, and in some ways not unlike the North Sea earthquake of June 7, 1931. Mr. R. E. Ockenden, however, has lately reprinted "Thomas Twyne's Discourse on the Earthquake of 1580" (Pp. 40+1 plate. Oxford: Pen-in-Hand Publishing Co., 1936. 5s.), the original of which is now very rare, though copies are to be found in the British Museum, Bodleian and Emmanuel College libraries. He has also given a most useful introduction and a bibliography of contemporary pamphlets and other works. From these, it appears that the earthquake was felt throughout the south-east of England, and so far at least as Oxford and Norwich, also in Flanders and the north-east of France. In Great Britain, several churches near the coast of Kent were damaged. Even in London, stones were shaken from St. Paul's Cathedral and the Temple Church, and an apprentice was killed by the fall of a stone from the roof of Christ's Hospital Church. Except perhaps at Calais, little damage to buildings occurred in France and Belgium. The sea was greatly disturbed, and it is probable, as Mr. Ockenden remarks, that the earthquake was of submarine origin, and that its epicentre was not far from the east coast of Kent.

### Radio and the Sunspot Cycle

L. C. YOUNG and E. O. Hulburt (*Phys. Rev.*, **50**, 45) have examined the correlation of radio transmission with sunspot activity over the years 1923–36. They find that the optimum radio-frequency for short-wave daylight transmission over a given long distance increases with the sunspot activity, and they derive a semi-empirical formula connecting these quantities. The correlation of the radio data with sunspot number is much better than with terrestrial magnetic activity or with the solar constant. The last fact suggests that the visible and infra-red radiation from the sun, on which the solar constant is based, does not vary in close accord with the ultra-violet radiation which ionizes the upper atmosphere.

### Structure of Benzene

ALTHOUGH the essential correctness of Kekulé's hexagon formula for benzene, with alternate single and double linkages, has been established by intensive chemical and physical investigation since its enunciation in 1867, and crystal analysis has shown that the ring is very approximately a plane, yet there are several other alternative formulæ (Dewar, Claus, Ladenburg, Thiele, Baeyer). The quantum-mechanical treatment of the problem has been dealt with by Hückel (1931–32) and by Pauling and Wheland (1933). Certain difficulties, however, were encountered in the comparison of the results with those of lines of experimental investigation. One of the most important was the apparent discrepancy between theory and experiment in the comparison between infra-red and Raman spectra. In a series of eight papers (*J. Chem. Soc.*, 912–987; 1936), C. K. Ingold and several collaborators have re-examined the matter in the light of the results of long-wave spectroscopy, which includes a study particularly of the infra-red and Raman spectra and the vibrational structure of bands arising from electron transitions. An important extension of the experimental method consisted in the substitution of hydrogen by deuterium, which does not alter the electron wave functions, so that the effect on vibration frequencies arises solely from changes of mass. Most of the coincidences in frequency in the infra-red and Raman spectra are shown to be the result of using liquids, in which cohesive forces disturb the conditions of symmetry, and the conclusion is reached that there is no need to assume the absence of a centre of symmetry in the benzene and hexadeuterobenzene molecules. The $D_{6h}$ model (plane regular hexagon) is supported, whilst the $D_{3h}$ (Kekulé) model fails to show itself in any spectroscopic features, and there is no indication of the $D_{3d}$ (puckered) model.

### Automatic Control of Road Traffic

IN the *G.E.C. Journal* of August, F. A. Downes gives a brief exposition of the elements of traffic flow and the requirements of automatic mechanism for controlling traffic. In the United States, traffic engineers have recently formed an Engineering Institution to study traffic problems. In Great Britain, the problems are studied by the engineers of the Ministry of Transport and by the staff of engineering works manufacturing traffic control apparatus. Of these engineers, there is probably no one who devotes his whole time to a theoretical and mathematical study of the subject. The design of modern traffic integrators requires a special knowledge of the mathematics of probability, and much useful work is being done in this direction. Theoretically, the only limit to the amount of traffic that can be dealt with by a single lane of traffic is that set by the limiting speed of the vehicles. For given road friction, and for a given average brake-power, it can be shown that there is a clearly defined optimum speed at which the greatest amount of traffic will be passed in a single lane per hour. The generally accepted figures lie between 12 and 18 miles per hour. At the lower speed, vehicles have 15 feet headway, but at the higher speed of 18 m.p.h. a headway of so much as 30 feet may be required. An optimum speed of 15 m.p.h. is often given, but this refers to dry roads of average surface. Unless a non-skid road surface is provided, this figure may be considerably increased. At intersections the first essential is a means of indicating 'stop' and 'go'. Interesting suggestions are made for indicating how soon change-over of colour may be expected. The full green indication, for example, consists of three concentric luminous rings; when one third of the time of the green signal has elapsed there are only two rings visible, then after two thirds only one. Another device embodies a dial divided into two portions, one of which is painted red and the other green, the indication being given by a large hand travelling in the clockwise direction.

# Hydrogenation of Coal: a French Process

THE hydrogenation of coal to produce liquid fuel is, as is known, a process now in technical operation. The French process as carried out at Béthune has been described by F. Vollette (*Bull. Soc. d'Encouragement pour l'Industrie Nationale*, 135, 353; 1936).

The coal and hydrogen must be brought into intimate contact by intense agitation, and the temperature must be increased progressively by passing the mixture through zones, sufficient time being allowed at 350° for pasty fusion and solution in the oil, and at higher temperatures up to 470° for the absorption of hydrogen. The apparatus consists of a bundle of long narrow tubes (*faisceau tubulaire*) united to one another by interior pipes like gas washing bottles, through which the hydrogen bubbles. The whole is heated in a cell of a coke furnace. The finely powdered coal is suspended in heavy oil and pumped at 200 kgm. pressure into the apparatus, where it meets a current of hydrogen from a compressor.

The volatile product, by cooling under pressure and removal of gas, is automatically divided into gas, heavy oil (at 300°) and light oil (atmospheric temperature). Very light petrol (5 per cent of the total light oil) is removed from the gas by adsorption on active carbon. Part of the gas is used for heating and part is mixed with the hydrogen. The heavy oil is used for the suspension of coal. The non-volatile product is partly hydrogenated with the heavy oil and partly carbonized to coke for making water-gas. The hydrogen is obtained from water-gas and steam and need not be pure: even coke-oven gas (50 per cent $H_2$) may be used.

The overall yield of light oil is given as 660 kgm. per metric ton of coal, and it contains 25–30 kgm. of phenol and cresols. Of this oil, 87·5 per cent distils below 300° and 27·5 per cent below 200°. The heavier fraction is further hydrogenated in the vapour phase under pressure in presence of a catalyst to give petrol, which is principally aromatic and hydro-aromatic. Lignite hydrogenates more easily than coal. From 660 kgm. of light oil, 460 kgm. of petrol are obtained, or 1 ton per 2·175 tons of coal. This requires 3,500 cu. m. of hydrogen, in making which 2·2 tons of coke are used. The steam used requires 1 ton of coal per ton of petrol and the electrical energy for compression of gas and works service consumes a further 2 tons of coal. Thus 7·375 tons of coal are used in making 1 ton of petrol, the calorific value of which is 20·75 per cent of the total fuel used.

# Biology of *Tridacna* and its Relatives

THE largest bivalves in the world belong to the Tridacnidæ. They have always aroused much interest in conchologists although little was known of the living animals. Size is not the only distinction in the family, for Prof. C. M. Yonge* shows that they are unique among the Lamellibranchiata in the relation of the mantle and shell to the other organs, and in the universal presence of zooxanthellæ in the tissues. In his peculiarly interesting monograph, there is a large amount of new matter clearing up much that was puzzling in these gigantic molluscs, which are among the most conspicuous members of the fauna of coral reefs in the Indo-Pacific region. *Tridacna derasa*, the giant clam, may be 4½ ft. long: the largest lamellibranch ever evolved, and may weigh about 4 cwt. The largest specimens personally examined were a little more than 3 ft. in length, and were so heavy that the combined efforts of two men failed to raise them.

There are two groups in the Tridacnidæ, the smaller boring forms, living in coral rock, and the larger species lying free on the surface of the reefs. All these clams normally rest on the hinge side of the shell with the edges of the valves pointing upwards. The pedal aperture, when present, lies close to the umbo. Thus, "as a result of a turning movement in the longitudinal plane, the dorso-ventral relations of the visceral mass and associated organs, on the one hand, and of the mantle and shell on the other, have become . . . the exact opposite of those in other lamellibranchs". This has given rise to much controversy as to whether the visceral mass has moved relative to the shell or whether the mantle has moved relative to the visceral mass. Prof. Yonge is now in the position to prove that the latter supposition is correct, and in this he is in agreement with Lacaze-Duthiers.

It is, however, in the amazingly efficient partnership with the zooxanthellæ that these molluscs are of outstanding interest. On this depends the whole problem of feeding, structure and evolution. Immense numbers of these zooxanthellæ always occur in the Tridacnidæ, housed primarily in the blood cells of the inner lobes of the mantle edges on the dorsal side where they are fully exposed to the light. In *Tridacna* these lobes extend far over the free edges of the shell valves in life, exposing a broad sheet of highly pigmented tissue. In the allied *Hippopus*, where there are fewer zooxanthellæ, the mantle edges do not extend in this way, but the shell valves open to a greater extent. The zooxanthellæ are confined to the blood sinuses, and are invariably contained within amœboid blood cells. Conical protuberances on the mantle edge, carrying lens-like structures, hitherto regarded as eyes, are here shown to be means whereby the internal illumination of the mantle

* British Museum (Natural History). Great Barrier Reef Expedition, 1928–29. Scientific Reports, Vol. 1, No. 11: Mode of Life, Feeding, Digestion and Symbiosis with Zooxanthellæ in the Tridacnidæ. By Prof. C. M. Yonge. Pp. 283–321 + 5 plates. (London: British Museum (Natural History), 1936.) 5s.

tissues is increased for the benefit of the zooxanthellæ. The phagocytes, carrying the zooxanthellæ from the mantle, surround the reduced diverticula and other regions of the gut and contain these algæ in all stages of digestion. *Tridacna*, and to a less extent *Hippopus*, consumes a number of these, so obtaining a significant amount of food.

The mouth is small, there is no sorting mechanism in the stomach, and the selective action of the gills and palps is highly developed, particles 14 μ in diameter being rejected. Assimilation and intercellular digestion take place in the much-reduced digestive diverticula and also in the phagocytic blood cells which may pass through the lumen of the gut. Indigestible material remaining in the phagocytes is presumably carried to the kidneys, which explains the abnormal size of these and the presence within them of a great number of large concretions.

The Tridacnidæ are profoundly modified for the housing and final digestion of the zooxanthellæ, and *Tridacna* may be considered the supreme example of the exploitation of associated algæ by an animal, although unlike *Convoluta roscoffensis* it never loses the power of holozoic nutrition, and so only the surplus zooxanthellæ are consumed. Experiments failed to reveal any significant production of oxygen or removal of carbon dioxide by the zooxanthellæ in the light, but they automatically remove all phosphorus excreted by the animal and even the phosphorus present in the water around. This may be the limiting factor controlling their abundance.

In no case known where there is a partnership of algæ with an animal has it been so highly evolved as in *Tridacna*, resulting in the actual farming of the zooxanthellæ by the mollusc. Every stage in the evolution shows a step towards this end. In a *Cardium*-like ancestor, it is suggested that the zooxanthellæ first settled in the region of the siphons, having been taken in with the food and so ingested by wandering phagocytes. This partnership being of advantage to both alga and mollusc, but especially to the latter, the mollusc became so modified in structure that the largest possible surface might be exposed in which the algæ could dwell near the light, whilst with a larger consumption of these the ordinary digestive organs were more and more reduced, a very good combined method of feeding being the result, the boring forms having evolved after this adaptation of structure and functions. It is found that boring is entirely mechanical and that the byssus takes an essential part in this process.

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# Bacterial Epidemiology and Nutrition

A TEAM of statisticians and bacteriologists who for many years have been investigating experimentally the spread of epidemics of bacterial diseases caused by *Bacterium aertrycke* and *Pasteurella muriseptica* in herds of mice under controlled conditions, have now summarized the results of their published work with the addition of some new observations, including an account of epidemics of ectromelia, a virus disease of mice[1].

To the epidemiologist the work is of great interest and value, and many important conclusions emerge from it. It is found that the average resistance of surviving mice increases with survival in a herd, but never becomes absolute, and in the long run the great majority eventually succumb to the reigning disease, nor will the disease ever normally die out provided the herd does not become too small. The increased average resistance displayed by surviving mice is attributed to natural immunization.

It is considered proved that artificial immunization does confer a high degree of resistance, being more effective in a virus condition like ectromelia than in a bacterial disease like mouse typhoid. Experiments on the influence of 'bacteriophage' on mouse typhoid yielded entirely negative results. It is considered that a major importance may be attached in the genesis of epidemics to the evolution or importation of 'epidemic strains' of particular bacteria or viruses, and that association of two infecting agents may play a part in determining the character of an epidemic.

It seems to be clear that the amelioration or disappearance of an endemic or epidemic infection is more often the result of a summation of effects, many of them unidentifiable, than of any single known factor.

Mr. Knight has recently brought together in convenient form the available information respecting bacterial nutrition[2]. Knowledge of the conditions favouring or inhibiting bacterial development is of importance in bacteriological technique and in the study and control of infective diseases and morbid states, as well as indicating relationships which suggest the possible evolutionary scheme of the bacteria, particularly as it relates to parasitism.

The report is divided into three parts, of which the first and longest gives a systematic survey of the known facts, and summarizes the chemistry of bacterial metabolism and the nutritional requirements of bacteria. In the second part, these nutritional observations are co-ordinated, a brief attempt is made to develop an evolutionary scheme, and the parallelism between nutrient requirements and the development of pathogenic properties and parasitism is illustrated. In the final part, methods are described by which bacteria may be 'trained' and 'adapted' to a simpler mode of life, and the mechanism of nutritional variation is discussed.

There is much in Mr. Knight's report of interest to the general bacteriologist, such as his critical review of the gaseous requirements of bacteria, the various methods that may be employed for the study of bacterial metabolism, and the differentiation of essential from accessory food substances in relation to bacterial growth.

[1] Medical Research Council. Special Report Series, No. 209: Experimental Epidemiology. By Dr. M. Greenwood, Dr. A. Bradford Hill, Dr. W. W. C. Topley and J. Wilson. Pp. 204. (London: H.M. Stationery Office, 1936.) 3*s*. 6*d*. net.

[2] Medical Research Council. Special Report Series, No. 210: Bacterial Nutrition; Material for a Comparative Physiology of Bacteria. By B. C. J. G. Knight. Pp. 182. (London: H.M. Stationery Office, 1936.) 3*s*. net.

## German Chemists at Munich

NEARLY three thousand delegates representing thirteen different German societies took part in a national congress of German chemists held at Munich on July 7–11. Prof. P. Duden of Frankfort presided at the general meeting, which was welcomed by Staatsminister Herr Adolph Wagner. Dr. O. Nicodemus of Frankfort delivered an address on the development of the chemistry of acetylene and its national importance as a source of raw materials. From acetylene many derivatives of the vinyl group can be made, which can be developed by polymerization to a great variety of valuable synthetic products. Amongst these may be mentioned the unsaturated hydrocarbons isoprene and butadiene, from which synthetic rubber is made, and a chlorinated derivative, chloroprene, which polymerizes seven hundred times as fast as isoprene and gives rise to an oil-proof synthetic rubber. By varying the conditions of polymerization, it is possible to plan the synthesis of products possessing specified physical properties, so that the range of application of these products is increasing rapidly.

Prof. Noack of Berlin then addressed the meeting upon the chemistry and physiology of plant structures. Afterwards the Congress broke up into twenty sections, which met for the discussion of special subjects, full reports of which will be found in the August number of *Angewandte Chemie*.

Although the main interest of the Congress was in applied chemistry, we find that one section was devoted to the history of chemistry, and a proposal was made to undertake the complete documentation and collection of publications (or copies) relating thereto. In a paper by Dr. Theis of Mannheim, the discovery of catalytic activity was credited to Döbereiner, who described in 1823 the ignition of hydrogen at atmospheric temperatures in the presence of spongy platinum.

Reference can only be made here to a few of the subjects discussed during the sectional meetings. Prof. Hedvall of Göteborg and Prof. Jander of Frankfort discussed reactions between substances in the solid state, Prof. W. Kuhn of Karlsruhe the properties of thread-molecules in solution and Prof. Staudinger of Freiburg the chemistry of macromolecules. Dr. Bredereck of Leipzig described his work on the constitution of the nucleic acids and Dr. Seidel of Munich his synthesis of urobilin. In the sections on applied chemistry will be found numerous papers dealing with fuel-oils, colours, paints, dyes, foodstuffs, building materials, leather, photographic materials, agricultural chemistry and many other subjects.

A whole section has been devoted to the consideration of the rapidly increasing number of *Kunststoffe* or artificial products. Among those of practical importance we may mention the 'organic' glass of Dr. O. Röhm. This substance, which is free from silicates, is derived from α-methylacrylic acid. Esters of the acid are colourless liquids, which polymerize, under somewhat difficult conditions, to vitreous solids, possessing a very high degree of transparency and a low coefficient of expansion. These glasses can be bent and moulded into shape at high temperatures and can be used for making windows for motor-cars and aeroplanes. They can also be used for optical purposes and for the manufacture of apparatus, such as filter-presses.

Another artificial product of first-rate importance is the substance trolitul, formed by polymerization of the hydrocarbon styrene, which is distinguished from most other artificial resins by reason of its excellent insulating properties, resistance to wear and impermeability to water. Thus it can be moulded into insulators and is suitable for employment even where high frequencies are used. The growing use of artificial products in industry has given new interest to the scientific study of complex polymers.

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## Science News a Century Ago

### Schönbein and Faraday

IN 1836, the long and interesting series of letters began between Schönbein and Faraday which extended over twenty-six years and was afterwards published with notes and comments by G. W. A. Kahlbaum and F. V. Darbishire. The first two letters were from Schönbein, who was then professor of physics and chemistry at Basle. The first was dated May 17 and the second September 12, 1836. Both dealt with experiments on the action of nitric acid on iron and the protective influence of a film of oxide of iron. The most curious thing Schönbein said he had observed was that iron wire could be made indifferent to nitric acid. Previous to this second letter, Faraday had communicated an account of Schönbein's investigations to the *Philosophical Magazine*, and in his letter of September 12 Schönbein wrote: "I feel much obliged to you for the kind manner in which you mentioned my late researches on iron in the philosophical Magazine. It is this kindness which encourages me to address to you a second letter on the same subject".

### Worcestershire Natural History Society

UNDER the above heading, the *Analyst*, 5, 160 (1836), records: "The ceremony of opening the museum of this Society took place on the 13th of September; on which occasion upwards of eight hundred persons attended, including a large proportion of the inhabitants of the county and city distinguished for their literary and scientific attainments. The Bishop of Worcester entered the room about twelve o'clock accompanied by the members of the council and at the request of the Hon. and Rev. J. S. Cocks took the chair". His lordship in a short speech congratulated the members of the Society upon the completion of the building and then called upon Dr. Hastings to deliver the inaugural address, "which was listened to with marked attention, and frequently elicited very considerable applause". About a hundred members and friends afterwards dined together, some admirable speeches were made and it was gratifying, said the *Analyst*, "to observe the interest which the prosperity of the Society appeared to excite".

### De la Rue on Voltaic Electricity

THE first scientific paper of Warren De la Rue (1815–89) was a communication to the editor of the *Philosophical Magazine* dated September 15, 1836, and entitled "On Voltaic Electricity, and on the Effects of a Battery charged with Sulphate of Copper". "The greatest effect," the author said, "being always produced in those voltaic arrangements where the chemical agent exerted an action on

only one of the metals constituting the battery, it occurred to me to use a saturated and perfectly neutral solution of the electro-negative metal, provided the other was capable of effecting its decomposition. I therefore tried the effect of a saturated solution of sulphate of copper in an elementary voltaic battery of the ordinary construction". After describing various experiments with his battery, he said, "It is worthy of notice, that after the batteries have been in action some time, a large proportion of the sulphate of copper is expended, and replaced by sulphate of zinc, *yet the action continues the same.* This naturally suggests using a saturated solution of any neutral salt, common salt, for example, and adding merely as much as the solution of copper as will serve for the time required. . . . I intend trying this, as I am still pursuing my inquiries on this subject, the object of which is to simplify as much as possible the voltaic battery. . . ."

### Death of Antoine-Laurent de Jussieu

ON September 17, 1836, the celebrated French botanist, Antoine-Laurent de Jussieu, died in Paris at the age of eighty-eight years. The nephew of the three brothers Antoine, Bernard and Joseph de Jussieu, who all contributed to botanical science, Antoine-Laurent was born at Lyons on April 17, 1748. On leaving school at the age of seventeen years, he joined his uncle Bernard de Jussieu (1699–1777) who was then a demonstrator at the Jardin du Roi in Paris, and after taking a degree in medicine became an assistant in the same institution. The collection of plants at that time was arranged according to the system of Tournefort. It becoming necessary to rearrange them, Jussieu adopted a new system suggested by what his uncle had done at Trianon, and from this grew the natural system described by Jussieu in his book "Genera Plantarum" published in 1789, the year in which the Revolution broke out.

As with so many other men of science, Jussieu for a time found his labours interrupted by the political upheaval, and in 1790 he became a member of the municipality of Paris, of which Bailly was Mayor, and was charged with the direction of the hospitals and charities of the city. In 1793, when the Jacobins came into power, the Jardin du Roi was reorganized as the Jardin des Plantes and Muséum d'Histoire naturelle, and Jussieu was made professor of rural botany. His colleagues included Lamarck, Daubenton, Saint-Hilaire, Fourcroy and Brongniart. He afterwards became director and treasurer of the museum and a professor in the faculty of medicine. In 1822 he severed his connexion with the school of medicine and four years later resigned his chair at the Jardin des Plantes, and was succeeded by his son, Adrien de Jussieu (1797–1853).

The natural system of classification of plants introduced by Jussieu was not appreciated at first as it ought to have been, and it was not until the writings of Robert Brown (1773–1858) that it made any headway in Great Britain. Besides his "Genera Plantarum" Jussieu wrote many memoirs, in 1796 published his "Tableau synoptique de la méthode botanique" and in 1800 his "Tableau de l'école de botanique du Jardin des Plantes". A statue of him now stands in the vestibule of the botanical gallery of the gardens. His son, who also was director of the museum, died leaving no male heirs, and the family, which for a century had been an ornament of science in Paris, became extinct.

## Societies and Academies

### Paris

Academy of Sciences, July 20 (*C.R.*, 203, 217–288).

LUCIEN CAYEUX: The coproliths of the North African phosphates. These coproliths consist of calcium phosphate, almost entirely free from organic or mineral inclusions.

LOUIS BLARINGHEM: The temperature of the spadices of *Arum italicum.* The temperatures are higher than the surrounding air: possible reasons for this are discussed.

LOUIS BOUVIER: Observations from the crayfish on the constitution of the side of the body-wall in the Crustacea.

ALEXANDRE GUILLIERMOND and MLLE. N. CHOUCROUN: An attempt at electrophoresis in the interior of plant cells.

MENDEL HAIMOVICI: Integral geometry on curved surfaces.

NORBERT WIENER and SZOLEM MANDELBROJT: Lacunar Fourier series. Inverse theorems.

JEAN MANDEL: The crumpling of a tube in a resistant elastic medium.

ALBERT PORTEVIN and LÉON GUILLET, JUN.: The elastic modulus of certain definite intermetallic compounds. Of the six compounds studied, CuZn, $Ag_3Sb$ and $MgZn_2$ obey the rule of mixtures, the others, $Cu_{31}Sn_8$, $Cu_9Al_4$ and $CuZn_3$ give elastic moduli 20–40 per cent higher than those calculated from the mixture rule.

CHOONG SHIN-PIAW: New systems of bands of selenious anhydride, $SeO_2$, of selenium, $Se_2$, and of tellurium, $Te_2$, in the ultra-violet.

NY TSI-ZE and CH'EN SHANG-YI: The displacements of the higher members of the principal series of rubidium by the rare gases. Study of the displacement of the lines of the spectrum of rubidium by helium (up to 12·75 atmospheres), neon (up to 13·59 atmospheres) and argon (up to 7·12 atmospheres).

ANDRÉ LALLEMAND: The application of electronic optics to photography.

JEAN REBOUL: A possible correlation between the intensity of the cosmic radiation and the velocity of certain chemical reactions.

PIERRE AUGER and MME. GRIVET-MEYER: Analysis of cosmic ray bundles by utilization of their divergence.

RENÉ DUBRISAY and JACQUES LEFOL: Study of the saline hydrates. The salt and a direct reading balance are placed under a bell-jar over a hygroscopic substance under reduced pressure, and the loss of weight studied as a function of the time. With crystallized copper sulphate over phosphoric anhydride, the curve of loss shows a sharp angle at $5H_2O$, and after ten days the weight is constant at $1H_2O$. Over dilute sulphuric acid (pressure of water vapour 0·85 mm.), $CuSO_4,3H_2O$ is the final product.

RENÉ DALMON: Heats of mixture of sulphuric and nitric acids free from water.

MLLE. VALÉRIE DEUTSCH: The adsorption of proteins. The serum albumen of the horse.

E. RINCK: Diagram of solidification and electrical conductivity of the potassium-cæsium alloys.

HENRI MOUREU, MICHEL MAGAT and GEORGES WETROFF: The two forms of phosphorus pentachloride. From a study of the melting and solidification curves of phosphorus pentachloride there would

appear to be a modification in the molecular structure. This is in agreement with the results of the study of the Raman spectrum: the latter shows that dissociation into phosphorus trichloride and chlorine does not take place under the conditions of the experiment.

J. JARROUSSE: Oxidation of diphenylpyruvic acid.

RAYMOND QUELET and MAURICE ANGLADE: The synthesis of 1-methoxy-2,4-dimethylolbenzene and of some of its derivatives.

ANDRÉ MEYER and PAUL HEIMANN: The products of halogenation and of oxidation of 2,4-dihydroxyquinoline.

PIERRE CHATELAIN: The geometrical and optical study of the crystals of *p*-azoxyphenetol.

EDMOND ROTHÉ and MME. ARLETTE HÉE: Study of a zone of contact of granite-gneiss by the observation of penetrating rays.

HENRI JEAN MARESQUELLE and RAYMOND SCHNELL: Experimental study of the phases of cecidogenic action in a gall.

MME. SIMONE BELLUC, JULES CHAUSSIN, JEAN COTTET, HENRI LAUGIER and MME. THÉRÈSE RANSON: Urinary yield, total molecular diuresis and diuresis of the elaborated molecules.

NICOLAS BEZSSONOFF and MME. MÉLANIE WOLOSZYN: The reversible oxidation of vitamin C present in a biological medium or in pure solution.

ACHILLE URBAIN and R. CAHEN: The amount of protein compounds in the serum of some ungulates.

A. and R. SARTORY, J. MEYER and MLLE. M. J. MERGLEN: Thermostable activating factors of cryptogamic origin favouring the growth of bacteria.

JEAN LAIGRET and ROGER DURAND: Virus isolated from mice and refound in man in the course of vaccination against yellow fever.

ANDRÉ BOIVIN: The comparative behaviour of the endotoxins and exotoxins towards trichloracetic acid.

BARUCH SAMUEL LEVIN and IWO LOMINSKI: Attenuation of the virus of bird plague by X-rays.

## Moscow

Academy of Sciences (*C.R.*, 2, No. 3, 1936).

N. KOSHLIAKOV: Integral for the square of Riemann's function.

S. U. UMAROV: The Brownian movement of a supported girder and the transverse vibrations of bridges.

S. A. ARCYBYSHEV, M. N. BOGOMOLOVA, N. V. BORISOV and I. CH. REPSHE: Penetration of copper and gold ions into transparent crystals of sodium and potassium chloride.

V. ANTONOV-ROMANOVSKIJ: Direct proof of the bimolecular scheme of the luminosity of zinc phosphate.

V. RASUMOVSKIJ: Intensity of the valence and the structure of molecules.

J. G. RYSS and N. P. BAKINA: Complex fluorides (2). Hydrolysis of boro-fluoride ions.

I. I. CHERNIAJEFF and A. M. RUBINSTEIN: Interaction of pyridine with the chloride and the bromide of blomstrand salt.

K. V. KOSIKOV: The influence of the age and sex of the germ cells on the frequency of mutations in *Drosophila simulans*.

N. I. SHAPIRO: Is there germ cell selection in *Drosophila melanogaster* ?

P. O. VELTISHCHEV: The plant mites (*Tyroglyphidæ*, Acari) as the main cause of failure of root-caoutchuc plants in Transcaucasia.

P. S. CHANTURISHVILI: Experiments in changes of sexual cycle in certain tail-less Amphibia.

## Sydney

Royal Society of New South Wales, July 1.

D. P. MELLOR and F. M. QUODLING: Optical properties and crystal structure of some compounds of the type $R_xMX_4$. The marked double refraction of many compounds of the type $R_xMX_4$ where $M$ = Pt, Pd, Ni or Au, is attributed to the existence of strongly anisotropic square co-ordinated ions. As yet, the structure of relatively few of these compounds have been analysed, but where this has been carried out the crystal optics agree qualitatively with those to be expected from the structures proposed.

## Tokyo

Imperial Academy, June 12 (*Proc.*, 12, 147–177).

T. KAWATA: Regular analytic functions in the half plane.

A. KAWAGUCHI: (1) Some intrinsic derivations in a generalized space. (2) Certain identities in a generalized space.

H. HOMBU: (1) Invariant theory of the integral $\int F(x, y, y', y'', y''')dx$. (2) Geometry of the integral $\int (Ly''' + M)dx$.

N. WATANABE and M. IMAIZUMI: Possibility of measuring a distance of 500 m. in terms of the wavelength of light.

T. KUME: Saturation of non-volatile substances in aqueous solution.

H. YABE and M. EGUCHI: Deep-water corals from off Owasi, Mie Prefecture.

Y. INAI: *Discosiphonella*, a new ally of *Amblysiphonella*.

S. ENDÔ: New fossil species of *Sequoia* from the Far East.

T. KOBAYASHI: Proparian genus of the Olenidæ, and its bearing on Trilobite classification.

## Vienna

Academy of Sciences, June 18.

JOSEF SCHINTLMEISTER: Origin of α-rays of 2 cm. range. The α-rays of this range, which have been found by several authors, do not come from any known element with atomic number greater than 44; they are probably due to element 61.

H. MARK and G. SAITO: Fractionation of highly polymerized substances by colorimetric adsorption analysis (1).

H. DOSTAL and R. RAFF: Mechanism of polycondensation reactions.

E. BARONI and W. KLEINAU: Nitration of phenols in chloroform.

O. BRUNNER and W. KLEINAU: The material forming the retina (3).

O. BRUNNER and E. BARONI: The material forming the retina (4).

## Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (BLACKPOOL MEETING)

### Monday, September 14

At 10 a.m.—Prof. H. L. Hawkins: "Palæontology and Humanity" (Presidential Address to Section C).

Prof. J. Hendrick: "Soil Science in the Twentieth Century" (Presidential Address to Section M, followed by discussion).

Dr. T. E. Allibone, Dr. G. W. C. Kaye, Prof. W. M. Thornton, R. Davis, Dr. S. Whitehead, C. W. Marshall: "Production and Technical Application of High Voltages" (Discussion: Section A).

Dr. D. A. Allen, Prof. W. J. Dakin, Dr. A. C. Stephen, J. A. S. Stendall: "Function of the Museum in Zoology" (Discussion: Section D).

At 10.45 a.m.—Dr. Ll. Wynn Jones, Prof. H. R. Hamley, W. A. F. Hepburn, Prof. J. Drever: "The Reform of the Examination System" (Discussion: Section J).

At 2.15 p.m.—W. Hammett, Dr. A. W. Greenwood, E. T. Halman, Dr. E. L. Taylor, A. J. Macdonald, J. Wilson, Dr. A. L. Romanoff: "Poultry Industry" (Joint Discussion: Sections D and M).

At 2.30 p.m.—E. H. Fryer: "Traffic Safety" (Discussion: Section G).

At 7.30 p.m.—P. A. Francis: "Applications of Science to Poultry Farming" (Public Lecture at Poulton-le-Fylde).

### Tuesday, September 15

At 10 a.m.—Sir Frank Smith, Dr. L. J. Harris, Dr. L. H. Lampitt, Dr. F. Kidd, T. Herbert, Prof. H. A. Denham, Dr. A. J. Smith: "Chemistry and Food Science" (Discussion: Section B).

The Right Hon. Lord Horder, Dr. R. D. Gillespie, Dr. E. P. Poulton, E. M. Killick: "The Strain of Modern Civilisation" (Discussion: Section I).

At 7.30.—Prof. C. M. Yonge: "Common Shore Animals" (Popular Lecture at Fleetwood).

Prof. D. Fraser-Harris: "Joy in Scientific Discovery" (Public Lecture at Thornton Cleveleys).

At 8.15.—Capt. F. Kingdon Ward: "Plant-Hunting in Tibet" (Evening Discourse).

### Wednesday, September 16

At 8 p.m.—Prof. Allan Ferguson: "Splashes and what they teach" (Public Lecture at Preston).

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ROYAL METEOROLOGICAL SOCIETY, Wednesday, September 16, at 8.15—(in the Lecture Hall of the Royal Society of Edinburgh, 22 George Street, Edinburgh).

Prof. F. Linke: "Moving Cloud Pictures".

R. H. Weightman: "Stratosphere Flight in America".

INSTITUTE OF METALS, September 14–18.—Annual Autumn Meeting to be held in Paris.

September 14, at 8.—Prof. P. A. J. Chevenard: "The Scientific Organization of Factories" (Autumn Lecture).

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX, September 18–21.—Annual Conference to be held in Balliol College, Oxford.

September 18, at 8.30 p.m.—Dr. Cyril Norwood: "The Library in the School" (Presidential Address).

September 19, at 9.30 a.m.—Symposium on "Library Instruction for University and Research Students in America".

September 19, at 11.30 a.m.—W. H. Johnston: "The Collection of Information for the Commercial Pages of a Great Daily Newspaper".

September 19, at 2.30.—Colonel L. Newcombe: "Union Catalogues, National and Regional. Their Preparation and Utilization".

September 19, at 8.30 p.m.—Prof. A. M. Carr-Saunders: "The Need for the Centralization of Information on Social and Economic Surveys".

September 20, at 9.30 a.m.—B. M. Headicar: "Government Publications, British and Foreign. Their Collection, Classification and Utilization".

September 20, at 11.30 a.m.—Dr. J. Edwin Holmstrom: "A System for Card-indexing Abstracts and Research Data, with Instantaneous Cross Reference".

September 20, at 8.30 p.m.—J. Grierson: "The Film in Industry: the Development of the Documentary Film and its Growing Use in Research and Advertising".

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## Official Publications Received

### Great Britain and Ireland

Norman Lockyer Observatory. Director's Annual Report, April 1, 1935–March 31, 1936. Pp. 6. Council's Report and Accounts, and List of Council, Staff, Members, etc. Pp. 10. (Sidmouth: Norman Lockyer Observatory.) [178

The Manchester Museum. Museum Publication 109 (Notes from the Manchester Museum, No. 36): New Greek Antiquities in the Manchester Museum. By Prof. T. B. L. Webster. Pp. 8+3 plates. 6*d*. Museum Publication 110 (Notes from the Manchester Museum, No. 37): Decorated Textiles from Yunnan (in the Museum) collected by Augustine Henry, 1896–98. By Laura E. Start and Mabel C. Wright. Pp. 26. 6*d*. Museum Publication 111 (Notes from the Manchester Museum, No. 38): Contributions to the Archæology of the Manchester Region. By Dr. J. W. Jackson. Pp. 10+2 plates. 6*d*. (Manchester: Manchester Museum.) [178

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 3: Rubber for Roadless Tractors and Trailers. By Alexander Hay. Pp. 14. (London: Rubber Growers' Association.) [218

Leeds University: Department of Pathology and Bacteriology. Annual Report, by Prof. Matthew J. Stewart and Prof. J. W. McLeod, with Abstract Report on Experimental Pathology and Cancer Research, by Prof. R. D. Passey. Pp. 16. (Leeds: The University.) [228

### Other Countries

Conference of Governors of British East African Territories: Research Conferences. Conference on Co-ordination of Tsetse and Trypanosomiasis (Animal and Human) Research in East Africa, held at Entebbe, 29th to 31st January 1936. Pp. 87. (Nairobi: Government Printer.) [188

Polska Akademja Umiejętności. Starunia, Nr. 8: Plejstoceńskie jezioro pod Jasłem (Pleistocene Lake near Jasło in Poland). By Władysław Szafer and Bronisław Jaroń. Pp. 20. 1 zł. Starunia, Nr. 9: Interglacjał w Samostrzelnikach pod Grodnem (Interglacial in Samostrzelniki bei Grodno in Polen). By Jan Trela. Pp. 8. 1 zł. (Kraków: Nakładem Polskiej Akademji Umiejętności.) [188

Republique Polonaise: Institut National Météorologique. Tables crépusculaires: donnant l'altitude au zénith des rayons rasants du soleil pour toutes les latitudes de degré en degré. Par Jean Lugeon. Pp. xxxix+438. (Varsovie: Państwowy Instytut Meteorologiczny.) 25 zł. [188

Nigeria. Annual Report on the Geological Survey Department, 1935. Pp. ii+27. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 2*s*. 6*d*. [208

Survey of India. Geodetic Report, 1935. Pp. v+101+20 plates (Dehra Dun: Survey of India.) 3 rupees; 5*s*. 3*d*. [248

Review of Agricultural Operations in India, 1931–32 and 1932–33. Pp. vi+408. (Delhi: Manager of Publications.) 5.12 rupees; 9*s*. 6*d*. [248

Trinidad and Tobago: Forest Department. Administration Report of the Conservator of Forests for the Year 1935. Pp. 18. (Trinidad: Government Printer.) 16 cents. [248

Fiskeridirektoratets Skrifter. Serie Havundersøkelser, Vol. 5, No. 1: Sydøstgrønland Jan Mayen; Fiskeriundersøkelser. Av Thor Iversen. Pp. 171+8 plates. (Bergen: A.s. John Griegs Boktrykkeri.) [248

Union of South Africa. Report of the Research Grant Board, 1918–1935. Pp. 85. (Pretoria: Government Printer.) 1*s*. 6*d*. [258

Colony and Protectorate of Kenya: Forest Department. Annual Report for the Year ended December 31, 1935. Pp. 40. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 1*s*. [278

Canada: Department of Mines: Mines Branch. The Canadian Mineral Industry in 1935. (No. 773.) Pp. iv+100. (Ottawa: King's Printer.) 25 cents. [278

South Australia: Department of Mines. Mining Review for the Half-Year ended December 31, 1935. (No. 63.) Pp. 87+5 plates. (Adelaide: Government Printer.) [278

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### Catalogues

Kodak X-ray Manual. Pp. 56. (London: Kodak, Ltd.)

Cressall Field Discharge "Shunt-Break" Switch-Fuses (for D.C. Inductive Circuits). (List No. 61.) Pp. 4. (Birmingham: The Cressall Manufacturing Co., Ltd.)

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# Science and Culture

THE part played by science in modern life, and the greater part it should play, are themes that offer appetizing food for thought to those engaged in scientific pursuits; but most laymen "look up and are fed not", regarding science as something abstruse and esoteric, and remaining content to enjoy its benefits without inquiring into their past or future. All devotees of science will therefore welcome the renewed efforts which the British Association is making to bring home to the public the nature and magnitude of the services rendered by science to the community, and the ways in which science enters *into*, and maybe colours, their daily life.

The most obvious effects of science upon man are the directly material: food, clothing, shelter, and so on. Less obvious are its effects upon social and economic conditions, due largely to developments in the use of steam, water, electricity and mineral oil as sources of power. The least obvious influence of science upon man is the way in which it has revolutionized his general intellectual outlook (*Weltanschauung*). It is to this last aspect that we would here direct attention, our reflections thereon having been prompted by the address with which Sir Richard Gregory opened the discussion on "Cultural and Social Values of Science" at the Blackpool meeting of the British Association.

One of the handicaps under which the man of science labours in communicating his thoughts to the outside world is the necessity for using abstract terms that defy precise definition. He may use far too many of them, but he must use some; so to avoid misunderstanding and confusion of thought, it is always desirable to start with a preliminary explanation of the meaning of the chief abstract terms he intends to employ. The word 'science', for example, is used very loosely in everyday life: to some it signifies a kind of magic—sometimes 'black' magic; to the schoolboy it is 'stinks' or 'bugs'; to many educated people it is an esoteric and recondite activity that touches human life but fleetingly and tangentially; the journalist uses it in describing boxing, cricket and other pastimes, and the advertiser in any way that helps to sell his wares.

For most people, probably the best definition of a science is 'a body of accurate knowledge', obtained by observation, often under experimental conditions, and sound reasoning. It would be going too far to elaborate this definition by discussing experimental technique, the nature of theories and hypotheses, and the kinds of reasoning, inductive and deductive, used by the research worker; but in any event effort should be made to disabuse the mind that science is a dull, lifeless thing, and that scientific workers are merely highly organized automata. Success in scientific inquiry, it might be pointed out, implies the possession of some of the higher human qualities, such as courage to look facts squarely in the face and to accept conclusions even when they are unpleasant or subversive of established practice and belief; patience; a disciplined imagination; an open mind and a critical outlook; and, perhaps the greatest of all, the artist's sense of striving for perfection.

Culture resembles science in having its roots in accurate knowledge and in critical thought. It is, however, more than knowledge or learning (a small amount of learning is compatible with a high degree of culture), because in concentrating on "the *best* that has been thought and known in the world", it becomes essentially a study of

perfection. Culture has therefore close affinities to science, art and ethics. Matthew Arnold, the nineteenth-century apostle of culture, took the view that the pre-eminent part of culture is not "the scientific passion, the sheer desire, to see things as they are", but such ethical elements as love for one's neighbour, beneficence, the desire to remove human error, confusion and misery, and the noble aspiration to leave the world better and happier than we found it.

The distinguishing feature of science would thus appear to be accurate knowledge, and that of culture to be taste, judgment or discrimination between the true and the false, the good and the bad, the beautiful and the ugly. Were Matthew Arnold living to-day, he would readily acknowledge the benefits that science has conferred on humanity in the directions he indicated. Has it not exposed many causes of human error and dissipated confusion of thought ? Has it not done wonders in preventing, alleviating and curing physical pain ? Has it not provided man with the physical means towards a fuller and richer life ? If science has not made man ethically better, that is not the fault of science, for it may be claimed that the golden rule of conduct—consideration for others—which is the foundation of morality and the non-material basis of happiness in communal life, is a valid scientific deduction from the data of experience. Emotion being a more potent factor in conduct than knowledge (*Pour faire quelque chose de grand il faut être passionné*), the contributions of science to "the good life" may compare unfavourably with those of art and religion, but it will be agreed that no conduct can in effect be good unless it conforms with the dictates of reason.

The influence of science upon the development of man, both as an individual and as a member of society, is apt to be overlooked by the historian. The pioneers of natural science, like Copernicus, Galileo, Bacon, Descartes and Darwin, by overthrowing the geocentric and anthropocentric doctrines of their times, and by establishing belief in the constancy of the order of Nature, freed the human mind from the fetters of dogma and unreasoning faith, and opened up possibilities of knowledge and attainment that we are now only beginning to realize and explore.

The services of these men, and of many others who have contributed to our knowledge of the universe and to the liberation of human thought, should be taught and discussed in our schools, and, generally, our educational curricula should be re-oriented in the direction of greater concentration upon the best that has been thought, known *and done* in the world, irrespective of time and geographical location. Our teachers need to be men and women of higher culture, seeking to emulate the great men of culture, who, as Matthew Arnold said, "have had a passion for diffusing, for making prevail, for carrying from one end of society to the other, the best knowledge, the best ideas of their time ; who have laboured to divest knowledge of all that was harsh, uncouth, difficult, abstract, professional, exclusive : to humanize it, to make it efficient outside the clique of the cultivated and learned, yet still remaining the *best* knowledge and thought of the time, and a true source, therefore, of sweetness and light".

The question arises, therefore, whether bodies like the British Association and the Royal Society cannot, in conformity with their statutes, tread the path of the diffusion of natural knowledge with greater vigour than heretofore. Neither body issues a publication which really hits the educational bull's-eye. The Association, it is true, enjoys what is called 'a good Press', but unfortunately that Press, in pursuit of commercial aims, largely selects matter that is calculated to create a sensation, and which seldom leaves a lasting impression.

We therefore suggest that the Council of the Association be urged to consider the advisability of publishing on its own account a special volume, to be available at a low price, containing those addresses, lectures, papers and discussions, or parts of them, which have a direct bearing upon the life of the community, and including descriptions of discoveries and inventions, new light on old truths, economic and social problems, and contributions to higher thought. Authors could be advised in advance that their contributions were ear-marked for dissemination among the public, and that therefore they should be written so far as possible in non-academic language, with a non-academic approach, and with the express object of arousing interest in and appreciation of the social and cultural implications of scientific research among those who are still largely ignorant of or indifferent to it. The first quinquennial review of the progress of science, prepared for the Association by a number of authors, and shortly to be published, though not entirely of this character, should be of great service in extending interest in scientific knowledge and achievement. Our hope for the future lies in enlightened education of this kind.

# Petrology and Movements of Snow Deposits

**Snow Structure and Ski Fields**: being an Account of Snow and Ice Forms met with in Nature and a study on Avalanches and Snowcraft. By G. Seligman; with an Appendix on Alpine Weather, by C. K. M. Douglas. Pp. xii+555. (London: Macmillan and Co., Ltd., 1936.) 25*s*. net.

OF all superficial deposits, that of snow is in its physical nature the most inhomogeneous and changeable, chiefly because it exists at temperatures so close to its melting point that melting, evaporation and sublimation are ever at work within the porous mass, modifying the characters of layers which were themselves distinctive when laid down. In consequence it is extremely difficult to predict the behaviour of snow on slopes, and losses in life and property due to avalanching are severe. Long experience has supplied a wealth of precepts to be followed by the wise snowcraftsman, but the reasons for them are imperfectly understood. The properties of the snow are determined by those of ice at the temperature involved, by the shape of the individual grains, their degree of interlocking and the cohesive force uniting them, whilst a further important control may be exercised by the presence of water. Mr. Seligman seeks to interpret avalanche lore in the light of our knowledge of the structure of the snow on deposition and its transformations under varying conditions, and he paints a vivid picture of the complexity of the problem.

The insufficiency of the available data is apparent, and it relates to both laboratory and field investigation. It is surprising that we should still be in almost complete ignorance of the properties and stability conditions of the vitreous state of so fundamental a substance as water, and much remains to be learnt regarding the internal structure and temperatures of accumulations of snow and ice. Only recently, Prof. H. U. Sverdrup has obtained evidence for the unexpected conclusion that in Spitsbergen, where the average annual temperature is − 12° C., the glaciers with the exception of a superficial layer subject to seasonal variation are at a temperature of 0° C. throughout, so that only the latent heat of fusion is wanting to remove them. The present work, which deals with the development of snow through all stages to compact ice, makes an opportune appearance in view of the increased attention now being directed to the subject as witnessed by the meeting of the International Commission of Snow in Edinburgh this year. Lavishly provided with beautiful illustrations, it should perform a valuable service in enlisting the interest of snow sportsmen in theory and observation.

Lack of precision in the terminology of the multitudinous forms of ice deposits has been responsible for much confusion in the past, and the author's definitions and analysis of foreign usages should pave the way for more fruitful discussion in the future. The classification and terminology adopted is on the whole satisfactory, although views will differ on details: thus the restriction of the 'glacier proper' to a moving mass of ice the surface of which is bare in summer, although convenient for the snowcraftsman, will not be acceptable to the geologist and physiographer. A somewhat careless employment of the terms 'condensation' and 'sublimation' will puzzle the non-specialist whom the book is cunningly devised to attract—the formation of super-cooled water drops is not a sublimation process—and it would be wise in view of the wide constituency addressed to limit 'condensation' to signify the passage from vapour to liquid only.

Mr. Seligman gives an admirable digest of the huge and undisciplined literature on snow and ice, and the arduous nature of his own field researches may be illustrated by his statement that on one occasion he spent two hours on a cornice in a fifty miles an hour gale attempting to make microscopic observations, all but a few minutes, however, being occupied in restoring circulation! The number of factors governing the form and interrelationship of the granules of a snow deposit is very great, and meteorological conditions exercise an important control over the processes active in the uppermost layers, whilst through the agency of freezing percolating melt waters, surface heat is delivered to the deeper layers and their structure modified. Snow phenomena provide Nature's greatest display of sublimation, and the author convincingly demonstrates the important role it plays in the development of structure, whereas regelation, which was formerly called in to explain many things, is now considered to be of minor application.

The origin of many avalanches is bound up with the stratification of the snow, in which beds laid down and altered under different meteorological conditions, and consequently of varied structure and properties, are insecurely welded to each other, and the elucidation of these matters properly belongs to the province of stratigraphical and

metamorphic geology. Mr. Seligman's book provides a stimulating record of the advances which have been made towards the solution of the problem of deducing meteorological history from the petrography of the deposits, and conversely the prediction of structure and mechanical properties from knowledge of past conditions. The perusal of Part 3, which treats of the different kinds of avalanches, the precautions to be taken in the hope of escaping them, and the procedure to be followed in attempting to rescue unfortunate victims, cannot fail to impress the reader with the hazardous nature of the snowcraftsman's exercise. The timid will keep away from the snow mountains, but happily for the growth of knowledge there are others. L. H.

# Poverty, Malnutrition and Disease

Poverty and Public Health
By G. C. M. M'Gonigle and J. Kirby. Pp. 278. (London: Victor Gollancz, Ltd., 1936.) 6*s.* net.

IN producing the book under notice, Dr. G. C. M. M'Gonigle and Mr. J. Kirby have made a practical and notable contribution to the study of community and family nutrition, which should help responsible authorities and individuals to acquire a true perspective and a sound sense of values in regard to the many factors which collectively influence the health of the general public. The authors write with the authority of first-hand experience. For many years their official duties have brought them face to face with the realities of poverty, malnutrition, disease and death in the depressed areas, and in the course of their work for the health and welfare of the local community in Stockton-on-Tees, they have collected data, instituted inquiries and made original investigations into the nutritional state of children and family health and economics.

Such is the background of knowledge and experience behind the publication before us. It has appeared at a time when the national conscience is alive to the significance of diet to health, and the fact that malnutrition is not merely a problem to be solved by satisfying hunger. The health and fitness of the nation are primarily determined by the state of nutrition of the people, and of necessity the food consumed by the individual child or adult must be physiologically adequate in respect of quality, quantity and balance if optimum nutrition is to result.

The book opens with an examination of available information relating to the physical condition of the adult population and the health records of elementary school children. The findings of the Ministry of National Service (1917–19) are reviewed, and the data revealed by the routine medical examination of elementary school children and special investigations are dealt with in detail. It is pointed out that in 1933 no less than 3,094,926 children, or 61 per cent of the average attendance at elementary schools, were subjected to examination by school medical officers, and that of these, 1,140,445 children, or 36·8 per cent of those examined, showed defects requiring treatment or calling for careful observation. The chapter dealing with child welfare records is of particular interest. In it the authors have presented a careful analysis of the data of 741 children who attended the child welfare centres in Stockton-on-Tees. They have correlated the incidence of defects with the evidence collected in regard to satisfactory or unsatisfactory diets. Bone defects, pharyngeal conditions, dental decay and anæmia were markedly more prevalent among the children whose diet was judged unsatisfactory. Attention is directed to the common error of including an excessive amount of carbohydrate food in the diet of children, and it is recorded that in Stockton-on-Tees a reduction in carbohydrate food coupled with an increase in protein, fat and vegetable constituents was followed by a decrease in rickets and other defects attributable to sub-optional nutrition.

A large section of the book is devoted to a critical analysis of the data obtained in Stockton-on-Tees of 152 families subsequent to being rehoused on a new housing estate. The health, mortality records and economic circumstances of these families are compared with those of 289 families which were not transferred to the new housing estate. The dietaries of the families in the two groups are examined, and it is held that the increased cost of rent on the new housing estate accounted for the unsatisfactory diet purchased. The intimate details of family budgetary expenditure are examined with great care and thoroughness. It is pointed out that in addition to rent, many other items in the budget are unavoidable, and their payment of necessity limits the money available for the purchase of food. In particular, the case of the unemployed is dealt with, and the book concludes with the well justified suggestion that the data presented are of sufficient importance to warrant further investigation and inquiry.

# Quantum Electrodynamics

**The Quantum Theory of Radiation**
By W. Heitler. (International Series of Monographs on Physics.) Pp. xi+252. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 17*s*. 6*d*. net.

THE quantum theory of the electromagnetic field is without doubt the 'difficult child' of quantum mechanics, which in spite of many attempts at improving it, has retained all the disquieting and unpleasant characteristics which it showed from its birth. There is a number of physicists who refuse to discuss it because, as they would put it, (*a*) it is unnecessary, since all its correct results can be derived by simple means; (*b*) it is wrong, because its application to problems like the self-energy of the electron leads to contradictions; and (*c*) it is extremely complicated.

In face of this opposition, it requires courage to devote a book to an exposition of this theory and its main applications. However, Dr. Heitler has a strong case against the opposition; for as to objection (*a*), the 'simpler' methods, namely, the quasi-classical introduction of the field in calculating the absorption, which is then related to the emission by means of Einstein's law, is, in fact, completely equivalent to quantum electrodynamics, both in the assumptions and in the procedure. Indeed, Einstein's law is based on Planck's radiation formula and thus on the concept of the light quantum, and therefore contains no more and no less than quantum electrodynamics itself. If we applied the 'simpler' procedure consistently, we should arrive at the same contradictions as in the usual form of quantum electrodynamics. Which of these methods one prefers is a matter of taste, but quantum electrodynamics has the advantage that, instead of requiring a new 'recipe' for each new type of problem, one can develop a general scheme to deal with all kinds of radiative processes and, from this, solve special problems by merely inserting appropriate values into the general formulæ. The importance of such a general scheme is emphasized by Dr. Heitler, and this will make his book very valuable in dealing with practical problems.

As for the argument (*b*) that the theory leads to inconsistencies, this is undoubtedly true. But as Dr. Heitler points out, we can always pick out those terms in the solutions which are significant as opposed to those which are due to the self-energy and do not correspond to reality. Thus in all practical applications we can obtain a definite answer, provided we do not require an accuracy exceeding a limit determined by the ominous number $e^2/hc$ or 1/137. In all cases, except possibly where very high energies are involved, these predictions agree with experiment, and we believe that whatever may be the form of a future theory, it is not likely to alter these predictions except for corrections of higher order in $e^2/hc$. This fact in itself justifies an account of the theory and its applications.

Nevertheless, we should keep in mind that the theory is, strictly speaking, inconsistent, and if Dr. Heitler calls it "the reasonable quantum theoretical extension of classical electrodynamics in the same way as quantum mechanics is . . . the extension of classical mechanics" (p. 81) he is perhaps too optimistic.

As for the objection of being complicated, this only makes a clear and comprehensive treatment more desirable. Moreover, from a study of this book the reader will find that although one cannot exactly call radiation theory an elementary subject, it is very much simpler than it would appear from most of the original papers, which —with few exceptions—were unnecessarily complicated.

The book starts with a short account of the classical theory of radiation, emphasizing the difficulties connected with the structure of the electron. The second chapter deals with the quantization of the field *in vacuo*, and contains an account of Bohr's work on the uncertainty relations for the field strengths and the limits of accuracy with which these may, in principle, be simultaneously measured. Then the terms describing the interaction with matter are introduced, and general formulæ for the probability of any radiative process are derived. Emission, absorption, photo-electric effect, scattering, dispersion and Raman effect, etc., are then discussed as applications of these formulæ. Complete results are given for those phenomena that are of particular interest in dealing with hard γ-rays and fast particles. Chapter iv deals with the theory of the positrons and their creation and annihilation, while the last chapter deals with the passage of fast electrons and γ-rays through matter. The limitations and difficulties of the theory are then summarized again, together with a short note on Born's attempt to remove them.

The exposition is very clear. The reader is assumed to be familiar with ordinary quantum mechanics and classical field theory.

It is, of course, unavoidable that there should be a few minor points on which author and reviewer disagree (for example, the statement that the field fluctuations have no connexion with the zero-point energy, p. 67), and a few places which leave the reader puzzled (such as, for example, the dotted curve in Fig. 7, or that a formula which has been derived "agrees roughly with what we should expect", p. 170), but their number is small. They do not affect the value of the book, which will be indispensable to anybody interested in either the principles or the applications of radiation theory. R. P.

# Chinese Materia Medica

**Chinese Medicinal Plants from the Pen Ts'ao Kang Mu, A.D. 1596**

Third edition of a Botanical, Chemical and Pharmacological Reference List. Compiled by Dr. Bernard E. Read. (Published by the Peking Natural History Bulletin, 1936.) Pp. xvi+389. (Peiping: The French Bookstore, 1936.) 6 dollars.

THE fact that this book, which gives the maximum of information in the minimum of space and therefore appeals only to experts, should have reached a third edition, is a striking testimony to the interest now being shown in the chemistry of plants. It is also a tribute to the learned author's success in accomplishing the remarkable literary and scientific feat of transmuting medieval Chinese materia medica into this thoroughly modern treatise on the medicinal plants of China. The data he has accumulated as a result of his labours are set out in tables giving the kind of information usually provided in books on materia medica, namely, botanical family, specific name, habitat, principal constituents, etc., but with the unusual addition of a bibliography of the chemical, medical and pharmacological literature of each drug.

Of the 898 drugs dealt with, many are either identical with, or closely related to, drugs still in use in Europe; others have long been obsolete in medical practice, and there are many which seem to be peculiar to China. None of the recognized cardiatonic drugs seems to have been used in China at the date, A.D. 1596, when this list was compiled. An interesting feature of the list is the inclusion of a considerable number of foodstuffs, especially fruits, nuts and cereals, a point to which Prof. Read directs particular attention as possibly indicating that the early practitioners had a sound, if empirical, belief in the importance of an appropriate dietary in the maintenance of health.

It is well known that Prof. Read's labours have already had the practical outcome of extending enormously the use of the alkaloid ephedrine throughout the world, but he probably has small hope of achieving similar triumphs with other constituents of Chinese drugs. At the present time, the investigation of natural drugs on the basis of local belief in their therapeutical value seems to be almost confined to Soviet Russia, Japan, China and India, and though interesting results have been obtained in all these countries, results of practical value, so far as additions to therapeutical resources are concerned, remain unimportant.

In other countries, work in plant chemistry is being carried on on broader and, in the writer's view, better conceived lines, in the correlation of components in allied species, the determination of the constitution of plant constituents and the investigation of the biological processes by which these substances are produced in plants. By these less direct methods much new knowledge is gained, and they are equally certain to lead in due course to the discovery of any still unknown plant constituents of therapeutic value.

To both the direct and the indirect worker in these fields, Prof. Read's book is a gift, the value of which can best be appreciated by those who have had practical experience in assembling all the relevant chemical, medical and pharmacological data regarding a single drug. To repeat the process with nearly nine hundred drugs, as Prof. Read has done, is to exhibit scientific altruism as rare as it is welcome. The careful and critical compiler rarely receives the credit he deserves for his indispensable work, and it must be some satisfaction to Prof. Read to be able to begin his introduction to the third edition with these words: "The large number of researches upon Chinese Materia Medica undertaken during the last decade necessitates a new edition of this reference list", for he is undoubtedly the cause of most of these researches, and his book may be cordially recommended as a source of information to any new worker who thinks of pegging out a claim in this field. T. A. H.

**British Association for the Advancement of Science**
A Scientific Survey of Blackpool and District. Prepared for the Blackpool Meeting, 1936, by various Authors. Edited by Arthur Grime. Pp. 152+3 plates. (London: British Association for the Advancement of Science, 1936.) n.p.

THE well-known British Association handbooks prepared annually for each centre visited have now for some years been issued in a uniform format, and if the appearance of the pamphlets is less impressive than the bound volumes of former days, the contents shows a marked improvement, and leaves little to be desired.

The handbook for the Blackpool meeting begins with an exhaustive survey of all aspects of the Fylde, illustrated by several useful maps. This includes chapters on the historical geography and the place names. A section of Lancashire sea fisheries follows. Then comes an account of the growth of Blackpool itself, from which we learn that there was a Blackpool of a few cottages so far back as the seventeenth century, and that the seaside resort began to be known in the eighteenth century. It was not, however, until the second half of the nineteenth century that the great growth set in. A full account is given of this growth and of the varied municipal activities of the borough. The coast defence works are also fully explained. Lastly come chapters on the geology and natural history of the Lake District, added no doubt in view of the excursions to that part of England. The book maintains the high standard of recent volumes in the series and reflects credit on its numerous contributors.

**A Method of Illustration for Zoological Papers**
By H. Graham Cannon. Pp. x+36. (London: Association of British Zoologists, 1936.) To Members, 2*s*. 6*d*.; to non-Members, 3*s*.

ALTHOUGH so much illustration of scientific papers is now performed by photographic methods there are still many cases where the process fails, such as complicated anatomical subjects, or those that present difficult problems of lighting or where a semi-diagrammatic treatment is called for. These require a selection and emphasis of parts which can still only be done by hand. The comparative ease and accuracy of the photographic process has done much to kill many of the older forms of art. Lithography, which in the past has produced such magnificent work, is almost as much a thing of the past as the woodcuts of Bewick. But as handwork is not, and never can be, entirely superseded, the student and advanced worker will be glad of any help that will get him over the technical difficulties in making his drawings. Everyone should at least try to produce his own illustrations with his own hand.

Prof. Graham Cannon has written a small booklet, published by the Association of British Zoologists, in which he claims that "any zoologist as long as he can draw a reasonably straight line . . . can turn out drawings that are really convincing". The method advocated appears sound and the illustrations of the method also appear convincing.

**Bibliography of Soil Science, Fertilizers and General Agronomy, 1931–1934**
Pp. xxxi+473. (Harpenden: Imperial Bureau of Soil Science, 1935.) 25*s*. net.

IN 1929–1930, eight Imperial agricultural bureaux were set up to act as clearing houses of information on different aspects of agricultural research and practice for the use of research and advisory officers in the Colonies and Dominions. One of their functions has been to issue abstracts of all the important papers and reports published in every country that bear on their respective subjects. The book under review is an index of all the papers abstracted by the Imperial Bureau of Soil Science, one of these eight bureaux, during the four years it has been issuing abstracts. It covers all the agricultural aspects of the work done in soil science, and in soil and crop management, but is only concerned with plant breeding, plant diseases or animal husbandry in so far as they depend on the soil or its management.

The book is an index of published papers. It gives the author, the title of the paper in English, the journal and the year in which it was published, but it does not give abstracts of the papers. The entries are grouped according to subject, or to the country to which they refer, and the subjects and countries are printed in the order of the numbers which they are given in the universal decimal classification. There is a detailed subject index running to fifty-five pages to enable one to find the number allotted to every subject, and it appears to be excellent.

There are three indexes, the subject index already noted, an index of all the journals quoted, and an author index. A minor criticism can be levelled at the author index in that it only gives one transliteration of a name from a non-Roman to the Roman alphabet, even though the author himself uses several.

E. W. R.

**Principles of Electric and Magnetic Measurements**
Part 1: Electricity, by P. Vigoureux; Part 2: Magnetism, by C. E. Webb. (The Student's Physics, Vol. 7.) Pp. xi+392. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 20*s*. net.

THIS text has the advantage that the authors are at the fountain of standardization in electrical science at the National Physical Laboratory and their modern treatment of their respective subjects is thereby enhanced. They start off by carefully defining their units and one is pleased to note the adoption of the new scheme of units based on the kilogram-metre-second system which is to unify the theoretical electro-magnetic and practical electrical units throughout the world in a few years time.

The present interdependence of physics and electrical technology is illustrated by the space given to thermionic devices, quartz crystals, the precision measurement of frequency, and even the linear timebase is mentioned, although, for some reason, the latter is not included in the index. The text is made suitable for students and research workers, but the field is becoming so vast that one must be sympathetic.

L. E. C. H.

# A New Fossil Anthropoid Skull from South Africa

By Dr. R. Broom, F.R.S., Transvaal Museum, Pretoria

FIG. 2. Side view of right upper maxilla with the 2nd premolar and the 1st and 2nd molars. Parts of the roots of the canine and 1st premolar are shown. Slightly enlarged. Photograph by Mr. Herbert Lang.

IT is nearly twelve years ago since Prof. R. A. Dart startled the world by the announcement of the discovery of a new type of fossil anthropoid found in a limestone cave at Taungs in Bechuanaland, South Africa. The specimen consists of most of the brain cast and the practically perfect face of a very young ape. The functional teeth are all of the milk set, though the first upper and lower molars have cut the gum but do not yet meet. Though the ape was only very young, Dart estimated the cranial capacity at more than 500 c.c., and considered that in an adult it might exceed 700 c.c. He believed that this little fossil ape is not very closely allied to either the chimpanzee or the gorilla, and that it is probably nearer to the ape from which man has been descended and thus to be practically the long sought for missing link.

Many European and American men of science considered that Dart had made a mistake, and that if he had had a series of young chimpanzee skulls for comparison he would have recognized that the Taungs ape is only a variety of chimpanzee. When after some years the lower jaw was detached from the upper and the crowns of the teeth could be examined fully, it was found that the milk teeth are not in the least like those of either the chimpanzee or gorilla, and that they agree entirely with those of man, though larger. In the gorilla and chimpanzee the first upper milk molars have each two cusps: in man and in *Australopithecus* there are three well-marked cusps in each. In the first lower milk molar of the gorilla there is only one large cusp; in the chimpanzee there is one large cusp and a second rudimentary cusp. In man and in *Australopithecus* there are four well-developed cusps.

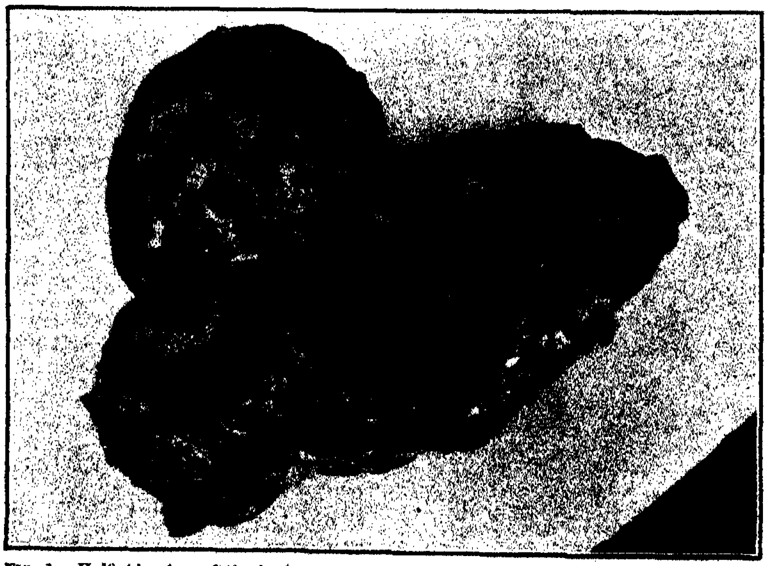

FIG. 1. Half side view of the brain cast resting on the imperfect base. The brow ridges are shown with parts of the frontal sinuses exposed. Part of the left cheek bone is also shown. About ½ natural size. Photograph by Mr. Herbert Lang.

I have constantly maintained since I first examined the skull in 1925 that Dart was essentially right in holding *Australopithecus* is not closely allied to either the gorilla or chimpanzee, and is on or near the line by which man has arisen.

I do not know what is at present the opinion in Europe as to where *Australopithecus* ought to be placed. Gregory of New York regards it as fairly near to the origin of the human line ; and Romer of Harvard says it is "clearly not a chimpanzee or a gorilla". But the most important thing to do seemed to be to get an adult skull. For the last three months, I have been busy working on the bone breccia of the limestone caves of the Transvaal largely in the hope of getting either a new 'missing link' or a type of primitive man. I have so far found no trace of man, though I have discovered more than a dozen new species of fossil mammals, a number of which belong to new genera.

FIG. 3. Crowns of right upper 2nd premolar and 1st and 2nd molars. × about [illegible]. Photograph by Mr. Herbert Lang.

Two weeks ago [Dr. Broom's covering letter is dated August 8.—Ed.], when visiting the caves at Sterkfontein near Krugersdorp, Mr. G. W. Barlow, the very understanding manager of the lime works there and on whom I had impressed the importance of keeping his eyes open for a Taungs ape, handed me the brain cast of what appeared to be a large anthropoid (Fig. 1). It had been blasted out of the side of the cave a couple of days before. A search for some hours failed to find any other part of the skull, but we found the cast of the top of the head in the cave wall. A more extensive search on the following day with a large party of workers resulted in the discovery of most of the base of the skull, with the upper part of the face (Fig. 2). In the same matrix was found the detached right maxilla with three teeth, and the third upper molar was also found, though detached. The lower part of the face had been removed before fossilization ; and so far no mandible or lower teeth have been found, though parts may yet be discovered in a mass of crushed and broken bones near the side of the head. As the bones are very friable, no attempt has as yet been made to remove them from the much harder matrix.

Much of the cranial vault has been destroyed by the blast, but a large part of each parietal is preserved and a considerable part of the occiput. Unfortunately, the back of the brain cast is missing, and though the base of the skull is complete to the back of the foramen magnum, the contacts of the occipital fragment are lost.

The brain cast is perfect in its anterior two thirds. When complete it probably measured in length about 120 mm. and in breadth about 90 mm. ; and the brain capacity was probably about 600 c.c. The skull probably measured from the glabella to the occiput about 145 mm., and the greatest parietal width was probably about 96 mm.

The brow ridges are moderately developed and there are fairly large frontal sinuses. The auditory meatus is 73 mm. behind the brow. It will be possible to make out much of the detailed structure of the base of the skull, but as yet no attempt has been made to clean it out as the bone is very friable and the investigation cannot be done in a hurry.

In the maxilla there are three well preserved teeth, the 2nd premolar and the 1st and 2nd molars (Fig. 3). The canine and 1st premolar are lost but the sockets are preserved. The canine has been relatively small. At its base it probably measured about 10 mm. by 8 mm. The 2nd premolar is somewhat worn. Its crown measured 11 mm. by 9 mm. Its pattern is well seen in Fig. 3.

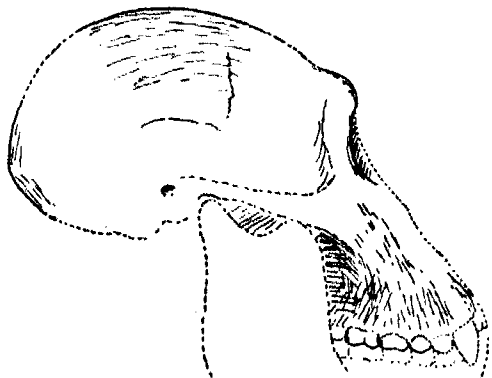

FIG. 4. Attempted restoration of skull of *Australopithecus transvaalensis* Broom. ½ natural size.

Sufficient of the cranium is preserved to show its shape with certainty. Most of the right maxilla is preserved, but it is not in contact with the upper part of the skull, and there is thus a little doubt as to the relations.

The 1st molar is moderately large. Antero-posteriorly it measures 12 mm. and transversely 13 mm. It is of the typical Dryopithecid pattern —four well-developed cusps with a little posterior ridge and a well-marked posterior fovea. The tooth agrees fairly closely with that of the first molar of *Dryopithecus rhenanus*. The 2nd molar is

exceptionally large. It measures 14·5 mm. in antero-posterior length and is 16 mm. across. It has four large cusps with a well-marked posterior fovea. The 3rd molar has been detached from the bone but it is preserved in perfect condition and unworn. It has three well-developed cusps, but the hypocone is relatively small owing to the invasion of the large fovea. The tooth measures antero-posteriorly 13·7 mm. and transversely 15·5 mm. The crown in this unworn condition is extremely wrinkled.

The whole premolar and molar series measures 59 mm.

This newly-found primate probably agrees fairly closely with the Taungs ape, but the only parts that we can compare are the brain casts and the 1st upper molars. The brain cast of the new form is considerably wider, especially in the frontal region, and the molar teeth differ in a number of important details. Further, the associated animals found at Taungs are all different from those found at Sterkfontein. I think the Taungs deposit will probably prove to be Lower or Middle Pleistocene, while the Sterkfontein deposit is most probably Upper Pleistocene. I therefore think it advisable to place the new form in a distinct species, though provisionally it may be put in the same genus as the Taungs ape.

This discovery shows that we had in South Africa during Pleistocene times large non-forest living anthropoids—not very closely allied to either the chimpanzee or the gorilla but showing distinct relationships to the Miocene and especially to the Pliocene species of *Dryopithecus*. They also show a number of typical human characters not met with in any of the living anthropoids.

# The Control of the Circulation of the Blood*

By Prof. R. J. S. McDowall

### Variations in the Activity of the Heart

THE heart is not like an ordinary pump which sucks fluid from one tube and pushes it into another. The veins are so thin that any degree of suction would cause them to close. The heart is filled by the pressure of the blood which reaches it during the time it is relaxed, and adjusts the force of its stroke to the amount of blood in it at the beginning of contraction. The more blood reaching it, the more it pumps out, within limits. This is made possible by the fact that the force with which the heart contracts is increased if the heart muscle is stretched.

The heart can also change its rate. In the past it has been usual to describe the heart as being under two sets of controlling nerves, one the sympathetic, which when stimulated makes the heart go fast, and the other the vagus, which makes the heart go slower. Now we know that this is only part of the story. The evidence is almost complete that the heart is really under the control of two sets of reflexes which have this function. The difference between these statements is that the second involves an afferent pathway to the central nervous system, for the sympathetic and the vagus are constantly carrying down impulses to the heart, and if they are cut off the heart goes slow or fast as the case may be. In the case of the sympathetic, we do not know accurately as yet the exact source of the afferent impulses, but the fact that stimulation of any sensory nerves causes cardiac acceleration suggests that the source is stimulation from the outside world. This is not necessarily conscious, for it has been shown that a sound may accelerate the heart of a person who is asleep, but during waking hours the higher centres undoubtedly play a part in the acceleration. I shall refer to this further in relation to the vasomotor centre. In the case of the inhibitory impulses which slow the heart, the source of the afferent impulses is known. These arise from certain sensitive regions within the circulation itself. These are situated in the left side of the heart, the arch of the aorta and the carotid sinuses, which are small dilatations at the bifurcation of the common carotid artery in the neck.

When exercise is taken, two changes occur: the sympathetic accelerator impulses increase and in particular the vagus impulses are reduced. The evidence for this rests on the effect of exercise and other procedures on the heart rate before and after section of the vagi, and with and without the sympathetic. It has been shown, for example, that if the vagus nerves have been cut the increase of the heart rate is, during the exercise, not nearly so great as it was before they were cut. It is not possible for me to discuss here how the change is brought about, except to say that it is in part due to the action of the higher centres and to a rise of venous pressure. The increased temperature of the blood and adrenaline liberated by the suprarenal gland enhance the effect of the nervous changes.

* From the presidential address to Section I (Physiology) of the British Association, delivered at Blackpool on September 11.

What I want to emphasize is that the range of acceleration is determined by the degree of activity of the cardio-inhibitory reflexes : indeed, it has been recently shown in Belgium that the capability of dogs to withstand sustained activity is apparently enhanced by removal of the sympathetic. The extent to which the animals have then to rely on the reduction of vagus activity is thereby increased. This, of course, does not mean that the maximum effort for short periods is increased. To show this it is necessary to time the running of the animal over short distances. It has been shown that in athletes during mild exercise the cardiac output is increased with a trivial increase in cardiac rate—that is, the increase is chiefly produced by an increased output per beat. I shall, however, return to this point. Meantime I should like to leave you with the question : The heart increases its output ; where does it get its blood ?

Experimentally it can be demonstrated that the vagus restraint of the heart is extremely variable—not only in different animals, but also in the same animal under different conditions, as may be seen if we block the vagi. For example, if we give an animal nitrogen to breathe, the normal vagus restraint can be shown to have disappeared. Or we can increase the restraint by previous sensory stimulation. This last experiment is of special interest, as it may give a clue as to how the normal vagus restraint is built up. We know that animals and human beings which take large amounts of exercise have slow hearts. How exactly this slow heart is produced is not yet clear. All we can say at the moment is that certain procedures such as sensory stimulation or asphyxia increase the heart rate, partly by reducing vagus activity, but that afterwards this reduction is followed by an increase in the activity of the vagus.

### VARIATIONS IN THE CALIBRE OF THE BLOOD VESSELS

It may be taken as a general principle that in physical exercise the blood is distributed to the active tissues at the expense of the less active tissues. This local dilatation of vessels, combined with a rise in the general blood pressure which is the result of increased cardiac output and constriction of vessels in less active tissues, results in an enormous increase in blood flow through the active muscles.

*The cause of the chemical dilatation* has been a matter of considerable debate. It has been demonstrated that blood issuing from tetanized limbs has a vasodilator action. There are first to be considered the products of carbohydrate metabolism—carbon dioxide and lactic acid. Each of these has been observed to cause vasodilatation if applied in suitable concentrations to capillaries under the microscope. I emphasize the concentration, because larger concentrations have the opposite effect. It may be demonstrated also that, if the vessels of the hind limb of a chloralosed animal are perfused with the nerves intact and carbon dioxide is administered, the perfused vessels constrict because of the action of the carbon dioxide on the vasomotor centre, but the blood-pressure does not necessarily rise, presumably because there has been a compensatory dilatation of vessels in the rest of the animal. A number of workers, especially Fleisch, have demonstrated that vessels are sensitive to most minute changes of hydrogen ion concentration, even that which is produced by the addition of the normal amount of carbon dioxide to the blood, and personally I think that normally this is the most important factor concerned.

There is, however, evidence that certain substances of protein origin may be involved. Of these the most important is histamine. It has recently been shown by Anrep that the vasodilator substance which is liberated into the venous blood gives all the known biological reactions for histamine, and it is possible to demonstrate that extensive tetanization of muscles may produce a state which is a very similar one to histamine shock. There is at the same time a constriction of pulmonary vessels such as is produced by histamine. This liberation of histamine—if it be histamine—is of interest, as biochemists have reported that, compared with other tissues, muscles contain relatively little histamine. It is, however, somewhat doubtful if we are justified in considering that what happens during a severe artificial tetanus necessarily occurs in normal exercise.

*The nervous dilatation* is, judging from the work of Cannon and his associates, probably sympathetic. Here we see a dual function of the sympathetic, for its constrictor action is much better known. It has been known for some time that the sympathetic contained vasodilator fibres. In order to show the vasodilator fibres in the sympathetic, it is necessary to paralyse first the vasoconstrictor fibres with ergotoxine (Dale), or to use slow rates of stimulation. In this connexion it may be remarked that this slow rate of stimulation may be an imitation of what normally occurs, since presumably ordinary muscle contraction may give rise to similar stimuli.

Once the exercise has begun, it seems likely that local vasodilator reflexes, similar to Lovén reflexes, are set up by afferent impulses arising within the muscles themselves, possibly as a result of the mechanical and chemical changes which take place. The evidence is somewhat scanty, but it is impossible to ignore any longer the possibility of the

existence of a nutrition reflex as suggested by Hess and supported more recently by Fleisch. By this is meant the fact that oxygen lack in a part sets up afferent impulses which result in reflex dilatation.

*Capacity effects.*—Now it has been shown by Krogh that when a muscle is active an enormous number of hitherto closed capillaries open up. This opening up of vessels previously closed necessitates the provision of blood, and as there is only a limited amount of blood in the body, it must be provided from other regions, otherwise the blood pressure would fall and the circulation through the tissues be reduced.

It is probable that practically all parts of the body, except possibly the voluntary muscles, the heart muscle and the brain, provide the blood necessary for the active muscles. It has been shown that any exercise, actual or even contemplated, causes vasoconstriction. Constriction of the spleen and of the intestine in animals has been observed. In man it has been shown that the vessels of the skin constrict under any emotional stress or even anticipated activity.

In regard to the sympathetic constriction of the vessels, we are in the same difficulty as we were in relation to the sympathetic acceleration of the heart. We do not know how the actual nerve impulses which originate the constriction arise. For convenience we say that they begin in the higher centres of the brain. It is, however, probably preferable, it seems to me, to consider that it is a sensory stimulation from the outside world, which is the point in time determining the psychical reaction which results in motor movement. Certainly we know that stimulation of a sensory nerve causes generalized vasoconstriction and commonly a rise of blood pressure, and that similar changes but of lesser degree may be recorded in a sleeping man.

It has been usual to ascribe the shutting down of the blood vessels solely to sympathetic activity, just as it was usual to ascribe cardiac acceleration solely to such action. In the case of the heart we have clear evidence that the reduction of the vagus restraint is just as important by increasing the range of cardiac activity and creating a cardiac reserve. It has now become evident that there probably exists an exactly parallel mechanism which increases the range of vascular activity and similarly enhances the reserve.

### Maintenance of the Vascular Reserve

Just as we have the restraint of the heart by the vagus, which determines the range of cardiac acceleration, so we have in relation to the blood vessels a set of reflexes which determines the magnitude of the vasoconstriction of the blood vessels; that is, they maintain the vessels of the body generally in an actively dilated state. The afferent impulses which are concerned in these reflexes have an exactly similar origin to those responsible for the vagus restraint of the heart. They arise from the cardio-aortic region and the carotid sinuses, and pass up the medulla by the aortic and carotid depressor nerves. Like the cardio-depressor reflexes, the vascular-depressor reflexes are operated by the intravascular pressure in these regions.

It has been generally assumed that the primary function of this control of the vessels is to maintain the arterial pressure at a constant level, and this is quite reasonable, for a constant mean pressure is desirable to maintain a steady flow of fluid at rest from the capillaries to the tissues.

More recently it has become evident that these reflexes may have another and possibly more important function. Several facts led to this suggestion: (1) in physical exercise or mental stress, the blood pressure, like the heart rate, does rise in spite of the reflexes; (2) the response of blood pressure to posture may be normal if the reflexes are destroyed—a fact which shows that the maintenance of mean pressure is not wholly dependent on the reflexes; (3) as in the case of the vagus, different animals, or even the same animals in slightly different circumstances, show great variability in the activity of the reflexes—often it is possible to throw the reflexes out of action without affecting the blood pressure materially; and (4), as might almost be anticipated, the conditions which reduce the activity of the vagus also reduce the activity of the depressor reflexes.

Now since in exercise the venous pressure is increased and, if the stress of the occasion is sufficient, adrenaline is secreted, we may consider what happens to the circulation when the vasodepressor reflexes are thrown out of action. As I have said, there is a rise of arterial pressure and a generalized constriction of the vessels. It has become usual to consider that this rise of arterial pressure is the result of an increased peripheral resistance to the flow of blood from the arteries. Were this wholly true, we should expect to find that there is a reduced flow of blood to the veins. If the animal, however, is in good condition, the reverse is the case: there is an increased flow to the veins. It is as if there were at the periphery a sponge-like reservoir which, when it is contracted, drives its store of blood into the veins.

When the depressor reflexes are cut off, the reverse, however, does not necessarily occur experimentally. An increased flow into the veins does not necessarily result in a rise of venous pressure, because at the same time the heart is stimulated and the increased pressure is rapidly

dealt with. It can, as might be expected, be shown at the same time that there is an increased output of the heart. It is not possible to measure the output of the heart by the cardiometer method without there being some degree of shock or permanent increased capacity of the circulation from the absorption of toxic products. As a result, the increased cardiac activity more than balances any increased flow in the veins, and the venous pressure may actually fall. Commonly it remains unchanged in such experiments. However, if the animal is not subjected to any severe operative procedure, a small rise of venous pressure is the rule. Perhaps I should say that several workers using the Fick method have shown an enormously increased output of the heart when the impulses from the carotid sinus are cut off.

What we can imagine happens in exercise or emotion is, then, that just as the vagus restraint of the heart becomes reduced, so also the depressor restraint of the vessels becomes reduced, more blood is thrown into the circulation and is dealt with by the heart, which at the same time increases both its rate and its output per beat. It is to be anticipated that we shall eventually get evidence that the extent of the activity of the vasodilator reflexes varies in different animals just as the activity of the vagus varies.

*The sympathetic and adrenaline.*—All the mechanisms which I have described are probably still further enhanced by the vasoconstrictor action of the sympathetic and the action of adrenaline, which is apparently secreted whenever the emotional stress of the occasion is sufficient. Adrenaline in physiological amounts constricts the vessels of the skin and splanchnic region and dilates the vessels of the muscles. Here I should like to emphasize that probably the physiological dose of adrenaline is minute, and may even be insufficient to raise the blood pressure. Certainly the dilatation of muscle vessels is not a result of the rise of blood pressure which may occur, for it can be shown that the dilatation occurs with doses which do not raise the arterial blood pressure. An increased blood flow through the limbs can also be shown to be brought about by doses which do not raise the blood pressure. In such circumstances the constriction just counterbalances the dilatation. Why adrenaline should constrict some blood vessels and dilate others is a major problem in the study of the circulation. Since so far as we know the vessels themselves have the same structure in different parts of the body, we must assume that the difference is due to the different environment. I had hoped by this time to have obtained some definite evidence on this point, but so far the experiments have not been completely successful.

It is interesting to observe the effect of adrenaline on the depressor reflexes. If the hormone is injected, it is found that some minutes afterwards, even after the usual rise of blood pressure has passed off, it is not possible to affect the heart by a degree of stimulation of the vagus which was previously effective, and at the same time the effects of cutting off the impulses from the carotid sinus are markedly reduced or completely abolished. This, of course, is exactly what would be expected if adrenaline were secreted in the same circumstances in which the action of the depressor reflexes and the vagus are reduced, as in exercise.

A further corroboration of this somewhat new view of the function of the vasodilator reflexes comes from a study of the effect of exercise and of emotion on man. It is well known that when a man takes exercise on a stationary bicycle his systolic blood pressure goes up, but falls even below normal the moment the exercise stops. This fall has been explained by Cotton, Slade and Lewis as due to the accumulation of blood in the vessels of the dilated muscles, but from what I have said in relation to the diminution of the peripheral resistance in muscle, it is evident that the fall is in part due to a diminution of this resistance. Now if a careful comparison be made of the psychical effect of intended exercise and that of exercise, it has been found by Gillespie that there is no difference. In other words, the rise of arterial pressure in exercise is the result of psychical changes.

If exercise could be taken without psychical zest being involved, we might expect the blood pressure to fall. This, indeed, has been found to occur in the horse. In man, too, it has been found that if the exercise is slight, although the systolic arterial pressure rises, the diastolic pressure falls. This means that more blood is being pumped out of the heart per beat, but that blood escapes from the arteries more rapidly than normally before the next systole. In other words, from psychical causes alone there is a rise of arterial pressure from an increased cardiac output per beat, which can only be the result of more blood reaching the heart. In emotion, too, it is known that the systolic pressure rather than the diastolic rises. Since we have seen from the experiments of Mosso with the plethysmograph, of Barcroft on the exteriorized spleen and of Florey and Florey on the exteriorized colon, that generalized vasoconstriction is an accompaniment of psychical effort, we must assume that the increased output of the heart is in part, if not wholly, the result of the vasoconstriction which calls into use the reserves of blood, and thus the circulation is maintained in spite of the greatly increased capacity of the active muscles.

# Chemistry and the Modern State*

By Prof. J. C. Philip, O.B.E., F.R.S.

IN relation to those essential activities of any society which is intellectually alive—the pursuit of new learning and the cultivation of the spirit of inquiry—chemistry is in the forefront. For the promotion of natural knowledge and the increase of our understanding of the universe, the chemist has laboured with extraordinary success, both in his own fields and in those borderlands where chemistry marches with other sciences. It is perhaps worth while glancing at one or two of the chief avenues in the region of chemical knowledge opened up by such fundamental research.

While our knowledge of atomic structure is to be credited mainly to the work of physicists, the chemist's technique has revealed the molecular architecture of the most complex natural products, and on the basis of this knowledge the same materials can be synthesized in the laboratory. One has only to think of the sugars, the alkaloids, the anthocyanins, to realize the astounding results which have been achieved in this field of investigation, while such elusive substances as the vitamins and the sex hormones are rapidly yielding their secrets to the strategy of the organic chemist.

Take, again, that region in the scale of size which lies between the molecule and the visible particle—the colloid region—the "world of neglected dimensions" as it was once described. In this region, as the physical chemist has shown, the relatively great extent of surface is marked by quite special behaviour, and the labile systems encountered exhibit peculiar characteristics—characteristics which are highly significant for the understanding of physico-chemical changes in the living organism. Our knowledge of this field of surface chemistry is still extending rapidly.

Once more, think of the tracking down of the factors which affect the rate of chemical change, and the elucidation of the mechanism of their operation: a little moisture, a speck of dust, a trace of acid, a roughened surface, a ray of light, a rise of temperature—any of these may have a notable influence on the rate of a reaction. The physical chemist has been remarkably successful in unravelling the role of these various factors and in interpreting their significance. It is in such a field as this—the field of kinetics and catalysis—that the progress of chemical science from the qualitative and descriptive way of treating phenomena to the rational and quantitative has been particularly marked.

These are only one or two of the directions in which the pioneering work of the chemist has opened the way to a fuller knowledge of Nature, especially in the more delicate aspects of her balance and her transformations. In the pursuit of natural knowledge for its own sake, the chemist has indeed travelled far, and his exploration has yielded an abundant harvest of discovery. For the pioneer himself it is an adventure, and original research may provide thrilling experiences. All this, however, is far from the common ways of men, and the investigator in the field of pure chemistry moves in a region mostly inaccessible to ordinary folk, and he speaks an unintelligible language, as indeed is true of specialists in other sciences. The so-called 'jargon' of science, inevitable as it is to some extent, presents a real difficulty in the transmission of knowledge and ideas from the specialist to the average educated man, but it should not be forgotten that other specialists besides scientific workers have a jargon of their own: to wit, lawyers, financiers, and even sportsmen.

It has been maintained that the pursuit of learning for its own sake is a selfish occupation; that knowledge should be a means to life, not an end in itself; that knowledge is of value only in so far as it leads to action, directly or indirectly. With this view I have much sympathy; but it has become abundantly clear, so far at least as knowledge and discovery in the realm of pure chemistry are concerned, that we must take a very long view indeed in assessing their practical value. Again and again in the history of the science observations and discoveries have been made, which at the time were of purely scientific interest but later received important practical applications. The laboratory curiosities of a former generation, such as aluminium and tungsten, have become the industrial commonplaces of the present.

The application of exact methods of measuring density revealed the presence of a new gas in the atmosphere—a discovery of purely scientific interest in the first place—which has led to a whole train of remarkable consequences, from a drastic revision of our ideas about the elements to the widespread development of illuminated signs. Just one hundred years ago, at the Bristol meeting of the British Association in 1836, Edmund Davy

* From the presidential address entitled "The Training of the Chemist for the Service of the Community" to Section B (Chemistry) of the British Association, delivered at Blackpool on September 10.

announced the discovery of a "new gaseous bicarburet of hydrogen", now familiar as acetylene. Decades passed, however, before the novel gas acquired any practical significance, and indeed it was not until 1892, when a large-scale method for producing calcium carbide was discovered, that acetylene became of industrial importance. Since then its applications have gone ahead rapidly, and its uses in illumination, in welding, in metal-cutting, and in the synthetic production of organic chemicals are widely known. In view of these lessons from the history of chemical science, one hesitates to apply the epithet 'useless' to any specific observation or discovery, however 'academic'. Reflection indeed suggests that the really big changes in the material conditions of human life have generally had their origin in a search for knowledge on its own account.

There is, however, much more to be said on this matter of fundamental or academic research. A solution of the most practical of chemical problems on rational and scientific lines is possible only because of our accumulated knowledge of natural phenomena and natural laws. It is only against the background provided by the pure research of yesterday that the technical problems of to-day can be viewed in their proper setting and tackled with a reasonable prospect of success. I would submit, therefore, that work in pure science, remote as it generally is from the practical issues of the moment, is building up a real reserve of knowledge and technique on which future generations of practical workers will be able to draw.

Apart from the chemists who are engaged, mostly in our universities and colleges, but to some extent also in the larger research institutes, in the general task of extending the boundaries of knowledge, there are many more who are carrying on what may be called 'directed' research. Their work aims at the solution of some specific problem, concerned, it may be, with the improvement of an industrial process, the elimination of waste, the safeguarding of health, the utilization of by-products, the synthesis of antidotes. More definitely, and by way of example, the object may be to discover a fast blue dye, to purify a water supply, to find a rustless steel, to produce petrol from coal, to isolate a vitamin, to make a non-inflammable film or a creaseless cotton fabric. The general public, however dubious about pure research, would probably admit that the satisfactory solution of any one of these problems would be of service to the community; but it must be emphasized once more that the chemist can do these things only by virtue of his inheritance of knowledge and technique. The attack on such problems, to have a reasonable chance of success, must be organized on the basis of what is already known and what has already been achieved; nay, more, one has abundant ground for belief that the attack, so organized, is bound to succeed, even though it may be 'in the long run'.

In the last twenty years, the amount of directed chemical research in Great Britain has increased enormously. Industries of the most varied description have begun to realize the potential value of the trained chemist in solving their special problems and putting their manufacturing processes on a more rational basis. In this general movement the State, through the Department of Scientific and Industrial Research, has taken a prominent part by fostering research associations. The work of these organizations—such as those dealing with rubber; with paint, colour and varnish; with cotton or wool; with non-ferrous metals; with sugar confectionery—is in many cases largely chemical or physico-chemical in character. The research associations have not only shown how general problems affecting an industry as a whole can be solved by joint research efforts, but also their existence and activities have induced a notable degree of 'research-mindedness' in the individual associated firms. Financially, the work is based on co-operation between the State and industry, on the principle that the State helps those who help themselves.

The State itself has founded a number of organizations for the study of chemical problems of national importance, and has thus formally recognized the significance of directed research for the community. The work carried out at the Chemical Research Laboratory, Teddington, has included the study of synthetic resins and low-temperature tars and the exploration of chemical reactions occurring under high pressure, as well as research on metal corrosion, chemotherapy and water softeners.

Fuel and food are two notable cases in which State-aided investigation is being carried out, and problems connected on one hand with pulverized and colloidal fuel or the low-temperature carbonization of coal, and on the other with the storage of fruit or the preservation of fish and meat, are being intensively studied at appropriate centres. Reference might be made also to the work of the Building Research Station, where, amongst other matters, the factors determining the weathering qualities of stone are being studied. Other experts than chemists are naturally concerned in the investigation of these problems, but the chemical and physico-chemical aspects are frequently the predominating ones.

Again, the serious question of river pollution has been taken in hand with State help, and some years ago a chemical and biological survey of the River Tees was set on foot, the Tees being chosen

for investigation because of the great variety of factory effluents discharged into it both in tidal and non-tidal reaches. Some of the newer industrial developments in Britain are presenting important problems in this direction. It has been estimated, for example, that if the waste waters from all the beet sugar factories in the country were discharged into our streams, they would cause as much pollution as untreated sewage from a population of four or five millions. The effluents from dairies and factories making milk products present a similar problem. Thanks, however, to research activity, largely at the instance of the Water Pollution Research Board, the disposal or purification of these and other trade effluents is being effectively achieved.

The question of river purification demands for satisfactory handling, as already indicated, the collaboration of other scientists with the chemist, and indeed the attack on many such problems, especially those affecting the health of the community, is likely to be successful only by the co-operation of teams of scientific workers from different fields. Smoke and fog, which not only present the scientific worker with interesting phenomena but constitute also a social and industrial problem of vital importance, concern the physicist, the physical chemist, the analyst, the fuel engineer and the meteorologist, and it is only when the knowledge and experience of these workers are pooled that there is any hope of interpreting the phenomena and solving the problem. Again, recent developments in cancer research make it clear that apart from the pathologist, who is mainly concerned, the chemist has a very definite contribution to make to our knowledge of this baffling disease. Some of the most fruitful scientific investigation, indeed, is cooperative in character.

Research, whether fundamental or directed, is by no means the only outlet for the chemist's knowledge and craftsmanship. The works control of chemical processes, the examination of factory products, the safeguarding of the purity of food, and the supervision of water supplies and sanitation, are examples of other activities of a more routine character in which large numbers of chemists are engaged. These are, so to speak, the general practitioners of the chemical profession, and their contribution to the smooth running of industry and to healthy living is far greater than most people suppose. I have myself been surprised, in a recent survey of the present occupations of my former students, by the extraordinary variety of the work in which chemically trained men may be engaged. This survey shows that photographic emulsions, beer, high-speed steel, printing ink, linoleum, dental cream, gramophone records, bank notes, and mineral waters, are a few of the materials with the production of which the chemist is concerned, either in the laboratory or the works. It is true to say that in the industry of the country the chemist is ubiquitous.

I have spoken of the 'chemical profession', and the phrase was used deliberately. A profession is a vocation demanding high educational and technical qualifications, and it connotes also the body of those who by virtue of their qualifications are able to serve the needs and welfare of society in some particular field. On all these counts, chemistry should have a place beside medicine, law and engineering. That the public is so slow in recognizing this claim may be due to the fact that the chemical profession is not yet unified to the same extent as the others mentioned ; but it is due also to a lack of realization of the fundamental and widespread character of the service which the chemist renders to the community.

A just estimate of the chemist's function is almost impossible for those who associate him chiefly with explosives and poison gas, and regard him as a particularly devilish kind of scientist. Such a picture is hopelessly out of relation with the facts. It is, of course, true that chemists have produced dangerous and poisonous substances, but most of these were discovered originally in the general quest for knowledge, and many have legitimate and valuable applications ; their use for destructive purposes is a perversion. Phosgene, for example, one of the so-called poison gases, was discovered more than a hundred years ago, and is an important material at the intermediate stage in the manufacture of certain dyestuffs. Nitrates, which are the basis for the manufacture of most explosives, play a prominent role as fertilizers in agriculture, and explosives themselves are indispensable in mining operations.

The truth is that the employment for other than beneficial ends of the substances discovered by the chemist is due, not to his especial wickedness, but to the weakness and backwardness of the human spirit. Like other scientists, the chemist normally has a constructive point of view, and he cannot but deplore the fact that, as Sir Alfred Ewing once said : "The command of Nature has been put into man's hands before he knows how to command himself". I think I speak for the vast majority of my fellow-chemists in saying that we dislike intensely the present world-wide prostitution of knowledge and skill to destructive ends. The sooner this is eliminated, and the less call there is for lethal and devastating materials, the greater will be our satisfaction.

There are, indeed, welcome signs that scientific workers are increasingly impatient at the extent

to which their knowledge is made to serve inhuman ends. The possibilities before humanity have been fairly set out by a recent historian, H. A. L. Fisher: "The developing miracle of science is at our disposal to use or to abuse, to make or to mar. With science we may lay civilization in ruins, or enter into a period of plenty and well-being, the like of which has never been experienced by mankind". To the clearing of this conflicting situation, the scientific worker has not always made the constructive contribution which he might have done: he has been content to adopt an objective and detached attitude, suggesting sometimes complete indifference to the wider human issues at stake, assenting too readily to the misuse of his knowledge and skill. Impelled by patriotic motives, most men of science have put themselves freely at the disposal of the State in time of need, but many are hesitating to admit that patriotism must always override considerations of humanity. Whatever be our individual attitude in this matter, it is time for chemists and scientists in general to throw their weight into the scale against the tendencies which are dragging science and civilization down and debasing our heritage of intellectual and spiritual values.

# Obituary

## Prof. A. P. Karpinsky

PROF. ALEXANDER PETROVICH KARPINSKY, the greatest of Soviet geologists, president of the Academy of Sciences of the U.S.S.R., of which he had been a member for fifty years, died on July 15 in his ninetieth year. He was a foreign member of many learned bodies; the Geological Society of London elected him a foreign member in 1901 and awarded him the Wollaston Medal in 1916.

An entire epoch in the history of Russian geology, following that of Murchison (the forties of the past century), is connected with Karpinsky's name. Karpinsky compiled a new, much more detailed geological map of the European part of the U.S.S.R. and the Urals. This map was the ground-work of the Russian geological service, of which he was one of the creators, and which was then known as the Geological Committee. Being during many years practically the head and leader of that institution, the staff of which was mainly composed of his pupils, Karpinsky was the creator of the new stratigraphy of Russia. This, however, does not exhaust the significance of Karpinsky's work in the history of geology. He was the last of those geologists who embraced the whole of geological science, working with equal skill in every branch of it.

Karpinsky's personal field-work in stratigraphy concerned all the systems and various regions of the European part of the U.S.S.R., but mainly the Urals; he was the first to solve the enigma of the eastern slope of the latter. His contributions which demonstrated the tectonic structure of the Russian platform were only completed, never reconstructed by later explorers, and were of immense value. He first established the regularity of movements of the earth's crust. Only much later did his ideas receive wider development in the theory of geosynclines.

Karpinsky's palæontological studies are of no less importance. Of his works on invertebrates the most remarkable are those concerning the palæozoic ammonoids. He was one of the first to apply the ontogenetic method, and not to single forms, but to a whole fauna. This led to most important conclusions both zoological and geological (he proved the evolution of the Artinskian fauna *in situ*, whereas it was considered immigrant). A most remarkable study is that on *Helicoprion*, a primitive shark, to the study of which he applied the histological method with brilliant results.

Particular attention may be directed to his monograph on Trochilisks—tiny Devonian algæ. To write this monograph, Karpinsky had to become a botanist. It is curious to note that in a controversy with botanists who did not share Karpinsky's opinion of these fossils, the victory went to Karpinsky. In petrology, besides special studies by which began his scientific activity, it is worth mentioning that he was the first in Russia to introduce the microscope in the study of petrographic slides.

From the very beginning of his scientific activity, Karpinsky was interested in deposits of useful minerals. He forecast the discovery of salt at Bakhmut, he advanced the view that petroleum deposits exist in the Urals; this has been brilliantly confirmed by recent prospecting for petroleum at Ishimbaievo, exactly in the Artinskian deposits established by Karpinsky, as well as by that at Krasnokamsk in the Middle Carboniferous. Karpinsky was particularly interested in the problem of the origin of platinum deposits; he studied some iron deposits and so on. He may be justly called the founder of the practical geology of the Urals.

Karpinsky continued working to his last days, and on his death bed he asked for paper to write down a new idea. In Karpinsky we lose not only the greatest Soviet scientist, but also an excellent man and citizen. Despite his high position, he never ceased to be modest, simple, accessible to everyone, especially to young students, at whose disposal he readily put his knowledge and experience. Injustice and untruth alone aroused his anger, and he frequently expressed his sympathy with the Soviet Government, which he used to call "the most just in the world".

A. BORISSIAK.

## Prof. P. H. Stroobant

We record with regret the death at the age of sixty-eight years, after a painful illness, of Prof. Paul Henri Stroobant, honorary director of the Royal Observatory of Belgium at Uccle. Prof. Stroobant had only recently retired from the directorship of the Observatory which, in May 1935, had celebrated the hundredth anniversary of its foundation. On the occasion of the centenary celebrations, which were honoured by the presence of King Leopold and attended by many foreign delegates, the new equipment of the Observatory was open to inspection. This equipment includes an elaborate Ascania meridian circle of 19 cm. aperture; a Cooke-Zeiss equatorial of 45 cm. aperture and 7 m. focal length, with micrometer; a double Zeiss astrograph, each telescope having quadruplet lenses of 40 cm. aperture and 2 m. focal length, covering a field of 72 square degrees; a Zeiss astrographic triplet of 30 cm. aperture and 1·5 m. focal length, covering a field of 81 square degrees; a 7° objective prism; a Zeiss reflector of 100 cm. aperture, equipped with two spectrographs; and also comparators and measuring machines. The modernization and reorganization of the Observatory was Prof. Stroobant's chief work as director, to which post he was appointed on May 1, 1925. He had previously been, since 1904, professor of astronomy in the University of Brussels.

Prof. Stroobant's astronomical work included the study of the personal equation in the observation of star transits; dynamical investigations on the planets and their satellites and, in particular, on the system of Saturn; researches on the distribution and number of the asteroids; investigations of the motions of the helium stars and of the solar motion. He was the first to establish that the apex of the solar motion and the velocity of the sun, with respect to the near stars, varies in a systematic manner with the spectral type of the stars. A volume entitled "Les Observatoires Astronomiques et les Astronomes", compiled in 1907 by Prof. Stroobant with the assistance of some of the staff of the Uccle Observatory, is a valuable reference work. A revised edition was published in 1931 under the auspices of the International Astronomical Union.

Prof. Stroobant was a *correspondant* of the Paris Academy of Sciences, of the Bureau des Longitudes, and of the Institut de Coïmbra. He was an associate of the Royal Astronomical Society, president of the Belgian National Committee of Astronomy and president of the Commission on Bibliography of the International Astronomical Union.

## Dr. Edward Weston

By the death of Dr. Edward Weston on August 20, the electrical industry loses one of its greatest pioneers. Born in 1850, on the border line between England and Wales, he went to the United States when fifteen years old and devoted his energies to studying the action of existing direct current dynamos and making improvements on them. If not the first, he was one of the first to realize the necessity of laminating the iron in the armature of a dynamo so as to obviate the heavy losses that otherwise occurred owing to the eddy currents induced by the alternating magnetic flux. Edison also worked on this problem, and the efficiency of the dynamo was soon raised from 50 to 90 per cent.

As a working method for the realization of the international volt, the Weston cadmium cell is used. At 20° C. its electromotive force is 1·0183 *international volts*. The researches made by Sir Frank Smith on this cell, and the modifications in the materials used to which these researches led, have made the Weston cell most trustworthy for the accurate measurement of voltages.

To electrical engineers, Dr. Weston's name is a household word in connexion with moving coil ammeters, voltmeters and wattmeters. The law governing a coil moving in a permanent magnetic field was used by Kelvin on his siphon recorders and by D'Arsonval in his galvanometer. In 1888, Weston, using this principle, developed and produced the first moving coil ammeters and voltmeters. Devices are now used by makers in all parts of the world for measuring amperes, volts and watts which use the essential principles of the original Weston instruments. In the original Weston D.C. ammeter, the coil is pivoted and is controlled by spiral springs which carry the current, but unlike the D'Arsonval galvanometer a pointer is substituted for the mirror. The ammeter can be converted into a voltmeter by using it in conjunction with a high resistance and into an ammeter for measuring large currents by shunting it with a low resistance.

Dr. Weston was the first to employ bakelite, so widely used to-day, on a commercial scale. Amongst his many inventions are a compensated thermocouple instrument for high-frequency A.C. measurements, the rectifier bridge for A.C. measurements and the first commercially practical dry disk photoelectric cell.

Dr. Weston was a past president of the American Institute of Electrical Engineers, and received many honours from learned societies. In 1933 he was awarded the Lamme medal of the Institute for his achievements in the development of electrical apparatus, "especially in connexion with precision measuring instruments". At the time of his death he was a director of the Weston Electric Instrument Corporation and the Weston Electrical Instrument Co. Ltd., at Surbiton. He is survived by his son, Mr. E. F. Weston, the president of the American company.

A. R.

We regret to announce the following deaths:

Dr. W. H. Harrison, formerly Imperial agricultural research chemist for the Government of India, lately acting agricultural adviser, on August 18, aged fifty-nine years.

Prof. K. K. Mathur, honorary professor of geology in the Benares Hindu University, and principal of the College of Science, Benares, on July 18.

# News and Views

### British Association Meetings

THE Blackpool meeting of the British Association closed on Wednesday, September 16, with the assembly of the general committee, when research committees were appointed and resolutions were passed gratefully acknowledging the obligations of the Association to the Mayor and Corporation for their hospitality and the ways in which they had contributed to the work and entertainment of the Association at Blackpool. The meeting has been notable in several aspects, and one which is unique of its kind was the opening of the famous autumn illuminations on Saturday, September 12, when Sir Josiah Stamp, president of the Association, switched on from a train the 300,000 coloured electric lights on pylons and archways which illuminated the whole length of the promenade. The day had been spent by a large party which travelled by special train to Furness Abbey, Windermere, Rydal Water and Grasmere; and upon the return journey the train was stopped at Oxenholme so that Sir Josiah could speak from his carriage to the people of Blackpool before he pressed the button which started the illumination of the five miles of the promenade. Sir Oliver Lodge, who was given an enthusiastic welcome at the opening meeting, when he expressed the thanks of the Association to Sir Josiah Stamp for his presidential address, attended a few other meetings before he left on Monday. His presence at Blackpool was much appreciated not only by his scientific friends but also by the people of Blackpool.

NEXT year's meeting is to be held at Nottingham under the presidency of Sir Edward Poulton. The general officers remain as this year; namely, general treasurer, Prof. P. G. H. Boswell, and general secretaries, Mr. F. T. Brooks and Prof. Allan Ferguson. The new members of Council are: Dr. F. W. Aston, Prof. F. Debenham, Prof. T. G. Hill, Mr. W. Campbell Smith, and Mr. J. S. Wilson. The meeting in 1938 will be held at Cambridge, on August 17–24. In January of the same year, it is proposed to send a limited party of the Association to India, when a joint session will be held with the Indian Science Congress, which will then be celebrating its silver jubilee. The 1939 meeting will be held in Dundee. The question of a meeting in Australia is still under consideration; but it will probably not be held there until 1942, as it has been found that 1940, originally suggested, is inappropriate on account of several important international congresses having been fixed for that year.

### Sir Edward Poulton, F.R.S.

THE election of Sir Edward B. Poulton to be president of the British Association for 1937 will cause great satisfaction, and is particularly apt in connexion with the renewed interest in Darwinism, and more especially in natural selection. This year's meeting has shown that there is a strong revival of belief in the efficacy of natural selection, and the presidential address to Section D (Zoology), and subsequent papers, demonstrated how much evidence is flowing along different lines to support the theory. The presentation to the world of Mendel's particulate theory of heredity in 1866 resulted in enthusiastic acceptance of the new doctrine and the belief that this process supplied the obvious means of evolution which would finally dispose of the less easily proved theory of natural selection. From this view, Sir Edward vigorously dissociated himself; but so prevailing was it that in the presidential address to the Association in 1913, Sir Oliver Lodge stated that not only was it not true that Nature does not make leaps, but that it was doubtful whether she ever does anything else. Now that the early conception of advance by large sudden changes has been so greatly fined down by the discovery of modifying factors, the two schools will be found to be less antagonistic. No one will rejoice in the reconciliation more than Sir Edward, himself eager to welcome and examine any new ideas on evolution, but always ready to hold the fort against new-comers with blaring trumpets acclaimed as the heralds of a new order.

SIR EDWARD POULTON is widely known for his exposition of the theory of natural selection as accounting for the colours of animals, particularly of insects; he has long been recognized as the chief authority on Darwinism in Great Britain. An Oxford man, having studied under Rolleston, he early distinguished himself as a morphologist; he was a vigorous supporter of Weismann's theory and took a practical part in making his views on the continuity of germ-plasm better known to the English-speaking public. But he became particularly interested in the problem of the colours of animals, and in his classical book, "The Colours of Animals", laid the foundations of his life's work. One general scheme was devised to cover all the manifestations of colour in animals, whether aggressive, protective, or for sexual attraction. The explanations by Bates and Müller of resemblances in colour between insects far removed in taxonomy found their keenest advocate in Poulton, who during forty years in the Hopeian chair of zoology at Oxford has been responsible for the accumulation of a mass of evidence for which no explanation has yet been put forward which covers so many points as does natural selection. Always ready to help in any work that would forward the study of evolution, he has consistently lectured and written as a supporter of Darwin's original views, as evidenced by his presidential addresses to the Linnean and Royal Entomological Societies, and to the zoological section of the British Association, which he has regularly attended since 1881.

### Discovery of a New Fossil Anthropoid in South Africa

IN another column of this issue of NATURE (p. 486) there appears a communication from Dr. R. Broom, of the Transvaal Museum, Pretoria, in which he records the circumstances of discovery in July last of the skull of a new type of fossil anthropoid in South Africa, and goes on to give a preliminary report on the more striking and significant anatomical characters of his find, so far as these are patent at this early stage of examination. The specimen, as was almost inevitably the consequence of its discovery in the course of blasting operations, is fragmentary; but fortunately for the student of the palæontology of man and the anthropoids, those parts which have been found, especially the teeth and the forward parts of the brain cast, are among the most significant for determining the relation of the new fossil to previously known forms. Further—and this is a matter of considerable moment—it is at once apparent that not only do these fragments belong to a new type of anthropoid, but also the teeth are those of an adult individual. Hence, as Dr. Broom points out, his find confirms the interpretation which has been placed upon Prof. Dart's Taungs skull, which is infantile, and establishes it by the side of this new and related specimen from the Sterkfontein caves, as "not closely allied to either gorilla or chimpanzee", but "on or near the line by which man has arisen". Dr. Broom, however, considers that he is justified in regarding his new form as differing specifically from *Australopithecus*, while it is probably later, belonging to the Upper Pleistocene. The further implication of his discovery is indicated when, referring to the resemblance in the teeth to those of *Dryopithecus rhenanus*, he emphasizes the fact that a South African Pleistocene form, showing "a number of typical human characters, not met with in any of the living anthropoids", stands in distinct relationship to the Pliocene fossil apes and especially to the Pliocene *Dryopithecus* of Europe, which some palæontologists have regarded as one of the most important links in the chain of relationship between the fossil apes of Europe, Egypt and Northern India and the earliest form of man.

### Science and Social Values

TIME and time again in these columns, reference has been made to the fact that men of science as a whole have, in the past, paid little attention to the social consequences of their investigations and discoveries, with the result that science has been widely blamed for the present-day world-wide unrest. While there is still a body of opinion that scientific workers should disclaim all responsibility for the use to which their discoveries are put, there is a growing feeling that men of science should take a more active part in public affairs. Sir Josiah Stamp, in his presidential address on September 9 to the British Association, referred to this topic, and went on to suggest that biological and social investigations should be given more attention than they are at present receiving. On September 10, Prof. J. C. Philip, in his presidential address to Section B (Chemistry) of the Association, part of which is printed in this issue of NATURE (see p. 492), roundly attacked those who find nothing in chemical science but explosives and poison gas, showing clearly the importance of the chemist in the modern State, though he found it necessary to urge upon his fellow chemists and other scientific workers the necessity of "throwing their weight into the scale against the tendencies which are dragging science and civilization down and debasing our heritage of intellectual and spiritual values".

ON the same day, September 10, President Roosevelt addressed a plenary session of the World Power Conference at Washington. According to the Washington correspondent of *The Times*, he said: "Your scientific and engineering genius is destroying one world—the world of relative scarcity—but has it yet undertaken to create the new world of abundance, which is potentially in your command, over natural energies? . . . Is enough attention being paid to 'human engineering'? In making a valuation of resources the physical and mental energies of human beings must be included." He added that a higher form of accounting is required which "takes the social values, now left to mere assumption, into its calculations and measures them". This frank statement from the leader of a great modern State, coupled with the movement from within their own ranks, will embolden scientific workers in their approach to the almost unknown fields which lie before them in social research.

### Joy in Scientific Discovery

DURING the past few days, a section of the lay press has been at pains to show by word and picture—apparently as a matter for comment—that scientific workers and others at the Blackpool meeting of the British Association have made use of the means of entertainment offered by that well-known resort, even as other folk do. That men of science can also feel and show emotion and pleasure in achieving success in their own special fields of work was the theme of Prof. D. F. Fraser-Harris's public lecture "Joy in Scientific Discovery" delivered at Thornton Cleveleys on September 15 in connexion with the Blackpool meeting. While it is true that scientific men must make an impersonal study of the laws of Nature, there is ample evidence from historical records of the joy they have felt on achieving their goal. Newton, it is said, was so agitated when his work on the law of gravitation approached completion that he had to beg a friend to complete his calculation. Faraday is well known to have greeted the successful conclusion of an experiment with boyish glee, and referred in writing of the life of the man of science to "the delight which the contented mind has in acquiring it [knowledge] for its own sake". Harvey said that "the pains of discovery are amply compensated by the pleasures of discovery". Malpighi was greatly stirred by his observation of the blood streaming through the capillaries. Jenner wrote joyfully to his

friend Mr. Gardner of his first successful vaccination. Pasteur had a sleepless night of anxiety when he had completed his first inoculations for rabies on a human being. Lister, a member of the Society of Friends, could write, "I don't think any case ever excited me so much", in referring to his first use of antiseptic ligatures. Graham Bell and Edison were delighted with the telephone and the phonograph respectively. Lord Kelvin, having devised a delicate electrical instrument, would have it brought to his drawing-room mantelpiece, so that he might exult over it at leisure. So the story continues. The joy of the creative intellect, whether in art, literature or science, is one of the most exalted human emotions.

### Drops and Splashes

Two public lectures under the auspices of the British Association were given at Preston (September 16) and at Rochdale (September 17) by Prof. Allan Ferguson, who took as his subject "Splashes and What They Teach". The lectures dealt with the phenomena attendant on the formation and separation of a drop of water at the end of a vertical tube, the splash of a drop of liquid falling into a liquid, of a solid sphere falling into a liquid and of a drop of mercury falling on to a horizontal sheet of glass. As is well known, experiments were carried out by Worthington some forty years ago in order to elucidate some of these happenings. Photographic technique was then very primitive, and Worthington's experiments were carried out under difficult conditions. Recently a high-speed camera has been developed, in which the film is drawn continuously through the camera at a speed of about thirty miles an hour. A prism rotating rapidly about a horizontal axis is placed between the lens system of the camera and the film, and throws a picture of the object downwards on the film, so that, for a fraction of a second, the image is stationary relative to the film. In this way it becomes possible to take pictures at the rate of 2,000 a second, and therefore, by running them through a projector at the rate of 20 a second, to alter the time-scale in the ratio of a hundred to one. The films so taken corroborate in a remarkable manner the results obtained by Worthington's method of taking separate photographs of drops, each at a different stage of its fall.

### Caucasian Studies

To remedy the neglect of a field in which the Russian literature, with a virtual monopoly created by circumstance, can do less than justice, a society has been founded in England for the promotion of Georgian and Caucasian studies. The promoters include Sir Oliver Wardrop and Mr. W. E. D. Allen, who are among the foremost authorities on Georgia in the West. Sir Denison Ross is the Society's first president. The Society will publish a journal under the title *Georgica*, of which the first part has already appeared. Its contents, for most of which natives of Georgia, recognized as authorities, are responsible, indicate that breadth of interest, combined with sound scholarship, will be the aim of its promoters. *Georgica* will also endeavour to keep its readers abreast of current developments in Caucasian studies not otherwise readily accessible. As preliminary matter, Sir Denison Ross contributes an introductory note explaining the objects and methods of the new society, and Mr. W. E. D. Allen reviews the present state of Caucasian studies. Among the remaining papers are a discussion of Georgian chronology by Prof. Taqaishvili, an examination of the Asianic element in Georgian paganism by Prof. M. Tseretelli (see p. 512 of this issue of NATURE), a census of Georgian manuscripts in England, of which there are three important collections, by the Archimandrite Peradze, and an account of the Holy Lance of Echmiadzin by Mr. F. J. Baddeley, who considers that it is identical with the lance discovered in the siege of Antioch in 1098. Dr. A. Gugushvili adds a valuable, if tentative, system of Georgian phonetics, which, it may be hoped, will lead to further discussion. The honorary secretary of the Georgian Society is Dr. A. Gugushvili, to whom inquiries should be addressed at Commonwood House, Chipperfield, Herts.

### Exhibition of Photography

THE eighty-first Annual Exhibition of International Photography by the Royal Photographic Society was opened on September 11. It will remain open daily (Sundays excepted) from 10 a.m. until 9 p.m. (Tuesdays and Fridays excepted—lecture evenings—when it will be closed at 6 p.m.) until Saturday, October 10. Pictorial photography occupies the principal galleries and, as usual, has attracted exhibitors from all over the world. Among the scientific exhibits are two infra-red photographs taken by A. W. Stevens and O. A. Anderson from about 69,780 feet above the ground over Central South Dakota on November 11, 1935. One of these is a vertical photograph, the other lateral. The latter is said to be the first photograph to show the division between the troposphere and the stratosphere. The horizon, 330 miles away from the camera, is clearly arched. The trade sections, though not extensive, are well worth inspection. The emphasis among apparatus is upon the miniature cameras. Instructional exhibits include explanations of the working of the Pola screens and of the Kodachrome process, the effects of varying the filter in making photomicrographs of stained sections and the troubles that may arise through mishandling photographic materials.

### Smoke Abatement Exhibition at the Science Museum

AN exhibition on the abatement of smoke will be opened at the Science Museum, South Kensington, by the Minister of Health, the Right Hon. Sir Kingsley Wood, M.P., on October 1, and will remain open until October 31. It has been arranged by the National Smoke Abatement Society (by permission of the director of the Museum, Colonel E. E. B. Mackintosh), with the co-operation of interested Government departments and industrial associations. Models and other exhibits demonstrating the efficient combustion of coal in steam-raising and other industrial operations will be shown, and other sections

will be devoted to the uses of other natural fuels, namely, anthracite and anthracitic coals, and oil. Another section will exhibit material relating to the generation, distribution, and uses of electricity. The pre-treatment of coal will be demonstrated by exhibits on high-temperature carbonization (gasworks practice) for the preparation of town's gas and gas coke, and on low-temperature carbonization, in which the product of principal interest is the semi-coke. For the scientific investigation of the smoke problem, methods for the measurement of smoke are required, and an exhibit of the Fuel Research Station will be concerned with current researches on this subject, which are being carried out with the view of developing a domestic fire that will burn coal smokelessly. The Department of Scientific and Industrial Research will show exhibits on the nature and causes of smoke, and on the investigation of atmospheric pollution. A section of the exhibition will be devoted to material demonstrating the effects of smoke. The Annual Conference of the National Smoke Abatement Society will be held at the Museum on October 14–17, and will be opened by Captain Harry Crookshank, M.P., Secretary for Mines. Particulars of this Conference may be obtained from the Secretary of the Society, at 36 King Street, Manchester 2.

### The World Power Conference

THE third World Power Conference, which was opened at Washington on September 7, was one of the largest technical conferences ever held. The British party, which travelled by the *Queen Mary*, numbered about a hundred. According to the *Electrical Times* of September 10, the records of the papers and discussions will run to more than three million words. As there was no hall in Washington large enough for a banquet of 3,000 delegates, the official banquets were held in the waiting hall of the railway station, suitably transformed for the purpose. Each country submitted papers to the Conference setting forth its own particular power problems and questions connected with them. Economic, technical and allied subjects were all discussed. The papers from each country having to be read before a mixed international audience, largely American, were naturally mainly reports of the country from which they originated. The British papers therefore were mainly of interest to all dwelling outside Britain. An exception may perhaps be made for the paper read by S. E. Britton, the city electrical engineer of Chester. His paper was entitled "Rural Electrification in Great Britain". When the use of electricity produces a revenue equal to twenty per cent of the outlay on the electrical distribution system, the inhabitants in rural areas can get a supply of electricity for all purposes at economic rates and use it for the same purposes as those residing in urban areas. Information is given of the annual expenditure on heat, light and power by those living in rural areas who use electricity and those who do not. The paper is clearly written and is very complete. It is particularly applicable to the conditions prevailing in the neighbourhood of Chester.

### German Chemical Engineering

ALTHOUGH a certain amount of publicity was obtained in the scientific journals, trade papers and the daily Press for the German Chemical Engineering Exhibition held at Cologne in 1934, the organizers felt that these reports were necessarily incomplete, and so they have published the Achema Jahrbuch, 1935–36 (Berlin: Verlag Chemie, G.m.b.H.), to give some indication of the recent progress in chemical engineering illustrated by that exhibition, which was visited by 48,600 representatives of industrial firms and professional men from forty-six countries. Opportunity is also taken of directing attention to Achema VIII, which will be held on July 2–11, 1937, at Frankfort-on-Main, where accommodation amounting to 240,000 square feet of floor space will be available for exhibitors. In this exhibition, one building will be reserved for firms wishing to show scientific instruments and equipment such as are used industrially for making technical measurements or controlling and regulating the flow of fluids, heat and electricity. Another building will house industrial apparatus made of non-metallic materials, whilst the third and fourth buildings are reserved for machines used in the artificial silk and associated industries, and large-size equipment for the chemical and allied industries respectively. It is intended to publish at the beginning of 1937 a catalogue giving detailed information of the exhibition. The "Jahrbuch" also gives a list of the exhibitors at the 1934 exhibition in English, French and German as well as notes in two of these languages on some of the more important sections and the equipment which was shown.

### Magnetic Observations in New Zealand and elsewhere

OWING to the world economic crisis and other causes, many magnetic and meteorological observatories, including those of some great nations, have fallen seriously into arrears with their publications. The ideal, approached, if not always attained, by the chief British observatories, is to publish the observations of one calendar year before the end of the next. Now that the great and successful co-operative effort of the Second International Polar Year has been accomplished—so far as the observations go, though the publication and, still more, the discussion of the results is still very incomplete—a desirable goal for new effort on the part of geophysical observatories would be to overtake their arrears of publication within an assigned time, say by the end of 1940. A step in this direction has been taken by New Zealand in publishing three years records of the Christchurch Magnetic Observatory in one volume (Annual Reports for 1931, 1932, 1933. Wellington: Government Printing Office, 1936. Pp. 132. 10s. 6d.). The volume naturally consists almost entirely of tabular matter, and for economy is reproduced directly from typescript, in a reasonably satisfactory manner. The magnetic data refer (as for 1930) to the Amberley sub-station, about twenty-five miles from Christchurch. Monthly mean daily variations are given for all days (with Fourier analysis) and international quiet days, but (regrettably) not for international

disturbed days. The volume includes a brief seismological report for 1931. An account of the instrumental equipment of the Observatory in the introduction would have added to the convenience of users. Though the director's introduction is written in the first person, his name (Mr. H. F. Skey), by a curious oversight, seems to occur nowhere in the volume.

### The Rockefeller Foundation

ACCORDING to the annual report for 1935, the Rockefeller Foundation expended 12,725,439 dollars. Of this sum 692,524 dollars was for medical education, including 460,850 dollars to the China Medical Board, 2,217,425 dollars on research programmes at universities and similar institutions, and 669,214 dollars on research programmes at research institutions and organizations. The report gives a brief description of the work of the International Health Division, the budget of which is 2,200,000 dollars; this Division covered yellow fever studies in Brazil, research on yellow fever, malaria and other diseases at the Institute's laboratories, field research on malaria in various countries, surveys to determine the status of hookworm disease in North Carolina, studies on tuberculosis, yaws and mental hygiene, as well as research on typhoid fever, smallpox vaccine and the common cold. Work in China has placed emphasis on organized efforts at rural reconstruction by assisting concrete studies and training personnel, particularly graduates, to participate in such reconstruction work.

IN the field of natural science, the Rockefeller Foundation has devoted its appropriations chiefly to research involving the application of the technique of the exact sciences to biological problems, particularly studies which contribute directly to, or form the necessary basis for, an understanding of behaviour. Grants have also been made for research on plant genetics, vitamins and hormones, physiology of reproduction and respiration, nerve physiology, etc. With regard to the social sciences, the Foundation is using its resources to develop specific areas of activity which promise to assist the solution of pressing social problems. The three areas of study thus far undertaken are social security, international relations and public administration, and the 3,807,500 dollars expended on social sciences in 1935 includes grants for research on problems of the business cycle, study of the relief situation in New York State, the Institute of Pacific Relations, agricultural economics, research on international relations and training projects in public administration.

### Science in Poznań

AMONG the contributions to vol. 21 (1936) of *Nauka Polska* is a long account (pp. 70) by Prof. Z. Lizowski of the present position of science at Poznań. This ancient centre of culture in western Poland has become the most intensely Polish of all the university cities in the country, partly because 95 per cent of its inhabitants are Poles and partly because of the impetus given to its development since the liberation of the country in 1918. From the time of the partition of the ancient kingdom of Poland until the end of the Great War, Poznań was nominally a German city, and although the pursuit of scientific investigations was possible it was hampered by cultural restrictions, including the suppression of the Polish language. Since 1919, a definite revival has occurred in all branches of pure and applied natural science and the university has attracted students, lecturers and distinguished visitors from other countries.

THE international character of science has also been promoted by the lectures delivered by Poznań professors in Germany, France, the United States, Czechoslovakia and elsewhere. This issue of *Nauka Polska* also contains particulars of prizes and awards distributed to men of science and to various scientific institutions throughout Poland during the past academic year. No complete figures are given, but it seems that many thousands of pounds have been distributed. Aerodynamics, investigations on the oxides of nitrogen, Grignard's reactions, rubber research and plant physiology are among the many investigations that are being encouraged with financial assistance. In the 'foreign notes' the attention of Polish readers is directed to the Oxford conference on 'academic freedom', whilst several works by British authors are included among the books reviewed.

### Rabbits in Britain

ATTENTION has been directed once again, by articles and correspondence in contemporary journals, to the damage caused by the superabundance of wild rabbits in Britain. An introduced animal, the rabbit, encouraged by conditions of soil, climate and food, has bred and spread, so that for the past century its activities have become increasingly harmful to agriculture and forestry. So long as two opposed views regarding its presence are strongly held, one emphasizing its destructiveness and the other its value as food and as an object of sport, it is unlikely that common action against the rabbit will be taken without legal compulsion. But the necessity for control in other countries and the methods employed for control are of general interest, and knowledge of them may become of great importance in Britain also, so that useful service is performed by Guy Dollman's article on "The Rabbit Menace" in the *Natural History Magazine* (5, No. 39, July 1936, p. 297), where a summary of recently developed means of limiting or eradicating the pest is given.

### Research in Plant Breeding

SUPPLEMENT 2 of *Plant Breeding Abstracts*, which has been issued by the Imperial Bureau of Plant Genetics, Cambridge (price 5*s*.), gives a concise account of work carried on during 1932–35 on crop plants in the British Empire. It shows the great variety of plants grown and the large amount of work in progress on such crops as wheat, cotton, rice, sorghum, coco-nut, apples, etc., gleaned from more than four hundred reports in various parts of

the Empire. It is so arranged that one can see at a glance, for example, the investigations of coffee that are being made in Mysore, Ceylon, Uganda, Kenya and Tanganyika, or of strawberries in England, Scotland, Canada, New Zealand and New South Wales. Work on cytology and on the genetics of plant parasites is included, and the whole serves as a very useful summary for plant breeders and geneticists. This outline picture also shows that a surprising variety of economic plants is undergoing genetic improvement.

### National Research Council of Japan

THE report of the National Research Council of Japan covering the period April 1934–March 1935 contains a useful list of papers published in various Japanese scientific journals during the period, together with brief particulars of divisional and committee meetings held during the year. A committee on dyestuffs research has been concerned with the investigation of standards of intermediates and dyestuffs and of the present state of industrial research on dyestuffs and chemical compounds in Japan. A further committee is concerned with radio research, and a committee on industrial research has considered the design of long-range aeroplanes, light-signalling through foggy atmospheres in daytime, the electrolytic oxidation of aluminium and its applications, material-testing by X-ray radiography and chloronaphthalenes as electrical insulators.

### Conference on Bee Diseases

A CONFERENCE to discuss the causes of bee diseases and the practical means of controlling them will be held on Saturday, September 26 at Rothamsted Experimental Station, Harpenden, Herts. Contributions will be presented by Dr. H. L. A. Tarr, of Rothamsted, on "Brood Diseases in England: the Results of a Three Year Investigation"; Dr. Guy D. Morison, advisory entomologist, Marischal College, Aberdeen, on "Bee Paralysis"; Dr. Otto Morgenthaler of the Bee Disease Division, Eidgenössiche milchwirtschaftliche und bakteriologische Anstalt, Liebefeld-Berne, Switzerland, on "Brood and Adult Bee Diseases in Switzerland". A paper on brood diseases in the United States specially prepared for this conference by Dr. J. I. Hambleton, Chief of the Apiculture Division, United States Department of Agriculture, will also be read.

### Announcements

SIR ARTHUR SMITH WOODWARD, Sir Charles Sherrington, M. Ruzicka and M. Bottazzi have been elected to the grade of associate of the Royal Academy of Belgium. Prof. F. Van den Branden, professor of clinical urology in the University of Brussels, and Prof. H. Fredericq, professor of zoology in the University of Liège, have been elected *correspondants* of the Academy.

THE following appointments have recently been made in the Colonial Service: E. J. H. Berwick, to be agricultural officer, Malaya; C. E. Johnson, to be agricultural officer, Northern Rhodesia; D. R. N. Brown, J. W. Purseglove, and J. M. Watson, to be agricultural officers, Uganda; J. E. Garfitt, to be assistant conservator of forests, Malaya; N. S. Alexander, to be professor of physics, Raffles College, Singapore; J. R. Clackson, to be European assistant, East African Meteorological Service; O. T. Faulkner, director of agriculture, Nigeria, to be director of agriculture, Malaya; J. E. A. Carver, assistant conservator of forests, Nyasaland, to be conservator of forests, Mauritius; J. S. Dunn, inspector of schools, to be engineering chemist, Public Works Department, Gold Coast; H. Harrison, field assistant, to be field officer, Tsetse Research Department, Tanganyika; J. Y. Moggridge, field officer, to be entomologist, Tsetse Research Department, Tanganyika; V. Rasaretnam, assistant superintendent of surveys, to be superintendent of surveys, Ceylon; C. L. Southall, assistant analyst, Straits Settlements, to be Government analyst, Nigeria.

PROF. CARL NEUBERG of Berlin, director of the Kaiser Wilhelm Institute of Biochemistry, has been elected a foreign member of the Swedish Academy of Sciences.

PROF. FRIEDRICH KÖRBER of Dusseldorf, director of the Kaiser Wilhelm Institute for Iron Research, has been elected a corresponding member of the Royal Swedish Academy of Engineering Science.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A city engineer and surveyor at Lincoln—The Town Clerk, Town Clerk's Office, Corporation Offices, Lincoln (September 19).

Assistants (Grade III) in the Meteorological Office—The Secretary (S.2.E.), Air Ministry, Adastral House, Kingsway, W.C.2 (September 23).

A civilian engineer by the War Department at Christchurch, Hants.—The Under-Secretary of State (C.5), War Office, London, S.W.1 (September 25) (Quote E.B.E.).

Assistants (Grade III) in the Royal Aircraft Establishment, South Farnborough, Hants (aeronautical engineering)—The Chief Superintendent (September 26).

A temporary engineer for work at Ellesmere, Salop, on purification of milk factory effluents—The Secretary, Rothamsted Experimental Station, Harpenden, Herts (September 30).

An assistant (Grade III) in the Air Ministry Scientific Research Pool (physics or engineering)—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (October 2).

An organizer of technical education in the Melton Mowbray district (who in due course will become the principal of the New Technical College)—The Director of Education, County Education Office, Grey Friars, Leicester (October 7).

Assistant quantity surveyors in the Air Ministry—The Secretary (W.B.9), Adastral House, Air Ministry, Kingsway, W.C.2.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 511.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Chemical Composition of the Planetary Nebulæ

THE physical conditions in the planetary nebulæ are such that atoms or ions in metastable states are not disturbed by electron impact or the absorption of radiation during their lifetimes of one minute or more. The intensity of a 'forbidden' emission line (due to transitions from such a metastable state) is then[1] $I = nh\nu$, where $n$ is the number of ions arriving in the metastable state per second, and $h\nu$ is the energy emitted from each transition. It is possible to determine the relative abundance of ions in the nebulæ from the observed[2] intensities of their forbidden lines (listed in cols. 5 and 7 of the Table), if, following Bowen, we assume the excitation to the metastable state to be due solely to inelastic electron collisions, that is, $n$ is proportional to $N(w)p(v,w)\rho(E)$, where $N(w)$ is the number of ions of atomic weight $w$ per c.c., $p(v,w)$ is the probability of electron collision and resultant excitation, and $\rho(E)$ is the number of electrons per c.c. with kinetic energy greater than the excitation potential, $E$, of the ion.

| Element At. Wt., $w$ | Ion Ion. pot. | Forbidden lines | Classification[1] $E$ | N.G.C. 7662 Line Int. $I$ | N.G.C. 7662 Abundance of ions, $N$ | N.G.C. 7027 Line Int. $I$ | N.G.C. 7027 Abundance of ions, $N$ | N.G.C. 7027 Abundance of atoms | Earth[3], abundance of atoms |
|---|---|---|---|---|---|---|---|---|---|
| N 14 | $N^{+}$ 14·48v. | λ6583 6548 | $^3P-{}^1D$ 1·9v. | ...... ...... | ...... | 26[4] ...... | <0·21 | $<6\cdot5\times10^{1}$ | $9\cdot3\times10^{-4}$ |
| O 16 | $O^{++}$ 34·93v. | λ5007 4959 | $^3P-{}^1D$ 2·5v. | 84[4] 32[4] | 1·00 | 118[4] 42[4] | 1·00 | 1·00 | 1·00 |
| A 40 | $A^{+++}$ 40·78v. | λ4740 4711 | $^4S-{}^2D$ 2·6v. | ...... 0·98 | $>7\times10^{-3}$ | 0·70 ...... | $>5\times10^{-3}$ | $>3\times10^{-3}$ | $3\cdot2\times10^{-6}$ |
| Ne 20 | $Ne^{++}$ 40·9v. | λ3968 3869 | $^3P-{}^1D$ 3·2v. | 2·6 7·15 | $>4\cdot9\times10^{-2}$ | 1·35 5·18 | $>3\cdot6\times10^{-2}$ | $>1\cdot6\times10^{-2}$ | $6\cdot0\times10^{-9}$ |
| S 32 | $S^{+}$ 10·3v. | λ4076 4068 | $^4S-{}^2P$ 3·0v. | 0·00 0·00 | >0·00 | ...... 0·19 | $>10^{-3}$ | $>3\cdot1\times10^{1}$ | $9\cdot0\times10^{-4}$ |

In N.G.C. 6572[4] the abundance of $Ne^{++}$ is 0·054 that of $O^{++}$.

[1] I. S. Bowen, *Rev. Mod. Phys.*, **8**, 69 (1936).
[2] H. H. Plaskett, *Harvard Coll. Circ.*, **335** (1928).
[3] Clarke and Washington, *Proc. Nat. Acad. Sci.*, **8**, 114 (1922) and V. M. Goldschmidt, *Fts. der Min. Krist. u. Pet.*, **17**, 114 (1933). The mass of the atmosphere is taken as 0·03 per cent that of the earth.
[4] Derived from line intensities given by L. Berman, *Lick Obs. Bull.*, **15**, 97 (1930).

The 'nebular' lines (that is, lines due to the shortest forbidden transition to the ground state) of five ions are listed in column 3 of the table (the 'transauroral' lines of $S^{+}$ are included). They are in the range λ6600–λ3800 and therefore have excitation potentials, $E$ (col. 4), between 1·9 and 3·2 electron volts, corresponding to a range of 25 per cent in $v$, the electron velocity. If we assume that $p(v,w)$ is constant in the small ranges of $v$ and $w$ here involved, the relative numbers of quanta in the forbidden lines, $I/h\nu$, derived from the intensities in cols. 5 and 7, are proportional to the numbers of ions in the nebula. With $O^{++}$ as standard, these values are lower limits to the relative numbers of ions when the excitation potential is greater than the 2·5 volts of $O^{++}$, because there are fewer electrons available to excite such ions (that is, $\rho(E)$ is smaller than for $O^{++}$); otherwise they are upper limits as indicated in cols. 6 and 8.

With a knowledge of the temperature of the ionizing radiation and its dilution, we can use the ionization formula[3] to determine the relative abundances of the elements from the proportions of their ions. The central star temperature is 50,000° K. for the nebula N.G.C. 7027 and the dilution (which is not simply geometrical dilution, but complicated by absorption in the inner layers of the nebula) was calculated from the measured ratio $O^{+}/O^{++} = 5\times10^{-2}$. (This was derived by the above method from the intensities of λ5007 and λ4959 relative to λ3726 and λ3729, the nebular lines of $O^{+}$, given by L. Berman[4]. Berman's published ratio must be corrected by +1·09 mag.) In this manner we arrive at the abundances listed in col. 9, corrected to relative numbers of atoms of the elements (for N.G.C. 7027). The proportions of oxygen, neon, and argon are approximately the same as of their ions, $O^{++}$, $Ne^{++}$, and $A^{+++}$, because their ionization potentials (given in col. 2) are so nearly equal. The $N^{+}$ and $S^{+}$ ions, however, form only a small fraction of the total amount of nitrogen and sulphur, which are present mainly as $N^{+++}$ and $S^{++++}$, and therefore the determination of nitrogen and sulphur content is of low accuracy.

The most surprising of these first quantitative results is the high abundance of neon and argon in the nebula. If the identification of the forbidden lines and also our assumptions are correct, we must explain a ratio of neon to oxygen $10^{6}$ times as great and a ratio of argon to oxygen $10^{3}$ times as great as on the earth (last col. of the table). There are two

possibilities: either (1) the nebulæ are normal in composition and the earth has lost neon, nitrogen, and argon, or (2) the earth is normal, and the nebulæ are low in oxygen and argon content relative to neon.

As regards (1), Russell and Menzel[5] have shown that light gases such as neon and nitrogen would completely disappear from the earth, if and when it were hot enough, long before heavier gases like argon even began to escape. Possibility (2) might be caused by the oxygen and argon at the low black body temperature in the nebula (15° to 20° K.) freezing out on dust particles (the presence of which in the nebulæ has already been suggested on other grounds[3]). The freezing points are: oxygen, 55° K.; argon, 85° K.; nitrogen, 62° K.; neon, 20° K. Unless almost all the oxygen were in combination in the dust particles, however, this still leaves unexplained the high content of argon which, freezing at a higher temperature than oxygen, should be more completely solidified.

We conclude that there is as yet no completely satisfactory explanation of these abundances.

T. L. PAGE.

University Observatory,
Oxford.
Aug. 25.

[1] I. S. Bowen, *Rev. Mod. Phys.*, **8**, 69 (1936).
[2] T. L. Page, *Mon. Not. Roy. Ast. Soc.*, **96**, 622 (1936).
[3] cf. Eddington, "Internal Constitution of the Stars", p. 383 (Cambridge, 1926).
[4] *Lick. Obs. Bull.*, **15**, 97 (1930).
[5] Russell and Menzel, *Proc. Nat. Acad. Sci.*, **19**, 997 (1933).

## Radioactive Isotopes of Bromine

FERMI and his collaborators[1] detected two unstable isotopes of bromine characterized by half-periods of eighteen minutes and 4·2 hours. The nuclear transformations are probably expressed by the equations:

$$(1)\quad {}^{79}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{80}_{35}\mathrm{Br} \rightarrow {}^{80}_{36}\mathrm{Kr} + e^{-};$$

$$(2)\quad {}^{81}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{82}_{35}\mathrm{Br} \rightarrow {}^{82}_{36}\mathrm{Kr} + e^{-}.$$

The isotopes 80, 82, of krypton are normal constituents of the element.

We noticed that when pure liquid bromine was exposed to neutrons for a week and then transferred to a thin-walled cylindrical glass cell encompassing a Geiger-Müller counter, the instrument registered twenty impulses per minute after a lapse of thirty hours. Previously we had observed the phenomenon in silver bromide precipitated from an irradiated aqueous solution of ammonium bromide. The time of half-decay is provisionally estimated to be twenty-four hours.

As a result of many experiments we conclude that the following reactions occur very infrequently, if at all:

$$(3)\quad {}^{79,81}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{79,81}_{34}\mathrm{Se} + {}^{1}_{1}\mathrm{H};$$

$$(4)\quad {}^{79,81}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{76,78}_{33}\mathrm{As} + {}^{4}_{2}\mathrm{He}.$$

Selenium, and arsenious sulphide, precipitated from irradiated solutions of ammonium bromide exhibit no long-period activity. This excludes, in particular, ${}^{78}_{33}\mathrm{As}$ ($t_{1/2}$=26 hours) as a possible source of the 'twenty-four hours' activity. The likelihood that it is due to another radioactive isotope of bromine or to an excited bromine nucleus is strengthened by the fact that we have not succeeded in separating the 'twenty-four hour' period from the other two; that is, all three activities in nearly the same relative proportions (small variations would be anticipated) have been observed irrespective of the form in which bromine is presented to the counter. Up to the present, *bromine, ammonium bromide, silver bromide, lead bromide*, and *ethylene dibromide* have been examined. To an irradiated solution of ammonium bromide, arsenic and selenium compounds were added, and pure samples of the three salts obtained from the mixture. Ethylene dibromide was prepared from radioactive bromine.

When, as in this case, the number of recognizable half-periods exceeds the number of isotopes in the natural element, several hypotheses can be suggested to explain their origin. Moreover, the half-periods are often difficult to determine precisely, and may sometimes be compounded of two or more. If there are, in fact, only three periods characteristic of bromine, the simplest explanation appears to be that a neutron is either absorbed, equations (1) and (2), or causes the expulsion of another neutron, thus:

$$(5)\quad {}^{79}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{78}_{35}\mathrm{Br} + 2\,{}^{1}_{0}n;$$

$$(6)\quad {}^{81}_{35}\mathrm{Br} + {}^{1}_{0}n \rightarrow {}^{80}_{35}\mathrm{Br} + 2\,{}^{1}_{0}n.$$

Fermi[1] discussed this type of collision, but did not observe it. Bromine atoms of mass 80 are produced by reactions (1) and (6), and until a fourth half-period can be shown to exist must be presumed identical. The isotope ${}^{78}_{35}\mathrm{Br}$ may emit a *positron* or an electron, becoming ${}^{78}_{34}\mathrm{Se}$ or ${}^{78}_{36}\mathrm{Kr}$. These are stable.

In our experiments the substances were exposed to fast and slow neutrons (and γ-radiation) produced by a mixture of beryllium dust and radium bromide. Fast neutrons are probably required to bring about reactions (5) and (6). The effect of varying the relative concentrations of slow and fast neutrons will shortly be investigated. The main results are summarized in the accompanying table:

| Half-period | Relative initial activity | Relative total activity |
|---|---|---|
| 18 min. | 8 | 1 |
| 4·2 hours | 3·5 | 6 |
| 24 hours (?) | 1 | 10 |

Figures in the third column are proportional to the total number of impulses given to the Geiger-Müller counter during the whole period of decay. They are of interest in connexion with the hypothesis suggested above, wherein isotope 82 is produced by absorption of a neutron, 78 by disintegration, and 80 by both processes, but an attempt to assign half-periods to particular isotopes would be premature at this stage.

C. H. JOHNSON.
F. T. HAMBLIN.

Department of Physical Chemistry,
University, Bristol.
Aug. 19.

[1] *Proc. Roy. Soc.*, A, **146**, 483 (1934); A, **149**, 522 (1935).

## Neutron Absorption of Boron and Cadmium at Low Temperatures

IN the same arrangement as used for silver absorption[1], we have measured the influence of temperature on the absorption of neutrons in Fermi's group 'C' by boron and cadmium, using the 2·3 min. silver activity as detector.

Absorption curves were taken with detector, source and absorber kept at room temperature in the centre of a large vessel containing liquid hydrogen (20·4° K.) or water (300° K.). The ratio of thickness giving equal absorption at different temperatures, $\sqrt{(300)}/\sqrt{(20 \cdot 4)}$, was found to be fairly independent of the absorption itself, its value being $1 \cdot 65 \pm 0 \cdot 20$ for boron and $1 \cdot 4 \pm 0 \cdot 25$ for cadmium.

The theoretical value to be expected from a $1/v$ law of absorption, assuming a Maxwell distribution, would be 3·84. Preliminary results on cadmium absorption in paraffin cooled by liquid nitrogen (77° K.) gave, for $\sqrt{(300)}/\sqrt{(77)}$, a value less than 1·1 in agreement with the results of Rasetti, Segrè, Fink, Dunning and Pegram[2] with the mechanical selector, and those of Dunning and others[3], obtained at 85° K. We therefore conclude that the absorption curve of cadmium has a selective character, though comparison with 20·4° K. shows that an increase of cross-section certainly exists at the lowest energies, presumably due to overlapping of a selective band with the usual increase obtained with most elements at very low energies.

The results with boron cannot be explained on the assumption of a $1/v$ law for both boron and silver, but it is not possible to decide whether this is not due to the deviation of the silver detector alone from the $1/v$ law, since experiments have not yet been made with a boron chamber as detector.

V. FOMIN.
F. G. HOUTERMANS.
A. I. LEIPUNSKY.
L. B. RUSINOW.
L. W. SCHUBNIKOW.

Ukrainian Physico-Technical Institute, Kharkov.

[1] *Sow. Phys.*, **10**, 170 (1936); NATURE, [**138**, 326 (1936)].
[2] *Phys. Rev.*, **49**, 104 (1936).
[3] *Phys. Rev.*, **49**, 650 (1936).

## The State of Ascorbic Acid in Plant Tissues

DURING the last two years, considerable discussion has arisen over the state in which ascorbic acid occurs in natural food materials. It is an experimental fact that some vegetables after being heated in boiling water exhibit an apparent increase in the amount of titratable ascorbic acid, which can then be extracted from the plant tissues.

Three explanations for this anomalous increase have been advanced:

(1) Heating breaks up the cellular tissue and allows a more complete extraction of ascorbic acid[1].

(2) A part of the ascorbic acid exists in a combined or esterified form which is hydrolyzed by heat or acid[2,3].

(3) Heating inactivates the oxidizing enzymes, thus preventing the oxidation of ascorbic acid[4].

The first explanation has been discarded, but the (2) and (3) have provided the basis for the present controversy. As a matter of fact, all the phenomena were noted by Tillmans and his associates[5] several years ago. They state that with certain vegetables the proposed titrametric method agreed with the biological assay method only if the oxidized ascorbic acid were reduced with hydrogen sulphide. The oxidation of ascorbic acid occurred during the extraction and might be prevented by heating before extraction or by extracting with stronger acid.

These facts have been insufficiently realized by later workers. Thus, Ahmad[2] considers that no oxidase was concerned, since raw cabbage extracted with cold 20 per cent trichloracetic acid gave a lower titre than boiled cabbage extracted with the same acid. The assumption that 20 per cent trichloracetic acid completely inhibits the enzyme action in cabbage is erroneous. In a forthcoming communication from this laboratory, it is shown that while the optimum $p$H for the reaction of ascorbic acid oxidase is about 5·5, a considerable activity persists at very much lower $p$H values. Although an oxidizing enzyme has been found in every one of nine vegetables investigated, its activity varies greatly. The oxidase in cabbage is barely inhibited by extraction with 1 $N$ sulphuric acid, in which case the $p$H of the extract is 0·8. Furthermore, it should be realized that while the final concentration of an extract may be 20 per cent trichloracetic acid, it is very much less than that in the crushed plant cells during the first few moments of grinding up the vegetable.

Recently, Guha and Pal[6] have reported experiments which are claimed to demonstrate almost conclusively that the increase in ascorbic acid content of certain foodstuffs on boiling cannot be accounted for on the oxidase theory. Alcoholic and ethereal extracts of cabbage are claimed to give an increase in ascorbic acid after heating. It should be pointed out that ascorbic acid oxidase is completely inactivated by both absolute alcohol and ether. Therefore any increase in ascorbic acid on heating these extracts has no bearing whatever on the oxidase theory, but must be explained by other means.

EXPERIMENTAL PROCEDURE

| Treatment | Ascorbic acid (mgm. per gm. of vegetable) Before Reduction with $H_2S$ | After Reduction with $H_2S$ |
|---|---|---|
| 1. 20 gm. cabbage extracted with 100 ml. cold water ... ... | 0·003 | 0·50 |
| 2. 20 gm. cabbage covered with 40 ml. cold water and heated 4 min. at 100° C. under $CO_2$. Extracted with 60 ml. additional water ... ... ... ... | 0·47 | 0·48 |
| 3. 20 gm. cabbage extracted with 100 ml. cold 1$N$ $H_2SO_4$ containing 2 per cent $HPO_3$ ... ... | 0·50 | 0·51 |
| 4. 20 gm. cabbage + excess $Na_2SO_4$ extracted with 100 ml. cold anhydrous ethanol ... ... ... | 0·51 | 0·54 |
| 5. 20 gm. cabbage + excess $Na_2SO_4$ extracted with 100 ml. cold anhydrous ethyl ether ... ... | 0·004 | 0·03 |
| 6. Extract (1) heated 4 min. at 100° C. under $CO_2$ ... ... | 0·04 | 0·47 |
| 7. Extract (1) made 0·2 per cent with resp. to HCl, let stand 1 hour ... | 0·006 | 0·43 |
| 8. Extract (1) made 1 per cent with resp. to HCl, let stand 1 hour ... | 0·008 | — |
| 9. Extract (4) heated 4 min. at 100° C. under $CO_2$ ... ... ... ... | 0·50 | — |
| 10. Extract (4) heated 10 min. at 36° C. under $CO_2$ ... ... ... ... | 0·47 | — |
| 11. Extract (5) air dried, then heated in 50 ml. water 4 min. at 100° C. under $CO_2$ ... ... ... ... | 0·004 | — |

I have carefully repeated the experiments of Guha and Pal and failed to observe any increase in ascorbic acid content on heating. Instead, the results show that the samples of cabbage examined in this laboratory did not contain appreciable amounts of ascorbic acid in a combined state. If the enzyme is inactivated by heat or alcohol, or inhibited by

extracting with *sufficiently strong acid*, the total amount of ascorbic acid is obtained. The fact that practically none of the ascorbic acid is recovered by acidifying or heating an aqueous extract indicates that nearly all the apparent increase on cooking is due to the inactivation of the enzyme. The slight increase on heating the aqueous extract may or may not be due to the liberation of bound ascorbic acid. I do not regard it as evidence of the existence of an ascorbic acid ester in natural foodstuffs.

G. L. MACK.

N.Y. State Agricultural Experiment Station,
Geneva, New York.
Aug. 3.

[1] Ahmad, *Biochem. J.*, **29**, 275 (1935).
[2] Ahmad, NATURE, **136**, 797 (1935).
[3] McHenry and Graham, *Biochem. J.*, **29**, 2013 (1935).
[4] Van Eekelen, NATURE, **136**, 144 (1935).
[5] Siebert, Inaug. Dissertation, Frankfort a. Main (1931); Tillmans, *Z. Unter. Lebensm.*, **63**, 267 (1932).
[6] Guha and Pal, NATURE, **137**, 946 (1936).

## Phosphagen in Echinoid Muscle and in Electrical Tissue

IT has been shown[1,2] that the electrical organs of *Torpedo* contain phosphagen, thus adding another to the series of resemblances already known to exist between electrical and muscular tissue. The possibility that both tissues may make use of the same or similar chemical mechanisms led us to study the electrical cells of *Torpedo* from the point of view of the interrelationships of certain of the phosphorylated compounds believed to be concerned in muscle chemistry.

It was found that the partition of phosphorus in the tissue is very like that in the muscles of the rat and the frog, and the following observations all serve to confirm the close resemblance already mentioned. (1) Extracts and breis prepared from the electrical organ will synthesize creatine phosphoric acid from creatine and phosphoglyceric or phosphopyruvic acid in the presence of adenylpyrophosphate or adenylic acid under conditions which lead to a similar synthesis in muscle preparations. (2) In dialyzed extracts this synthesis is catalyzed by the magnesium ion. (3) Phosphoglyceric acid is converted into pyruvic acid (demonstrated by the nitroprusside reaction and by the formation of a crystalline 2–4–dinitrophenylhydrazone). (4) Phosphagen can be synthesized from adenylpyrophosphate in high concentration without the addition of phosphoglyceric or phosphopyruvic acid. (5) Adenylpyrophosphate is rapidly dephosphorylated by such tissue preparations.

Hence this electrical tissue, like muscle, contains enzymes capable of catalyzing the following reactions:

(1) Phosphoglyceric acid → phosphopyruvic acid;

(2) Phosphopyruvic acid + adenylic acid → adenyl pyrophosphate + pyruvic acid;

(3) Adenylpyrophosphate + creatine → adenylic acid + phosphagen;

(4) Adenylpyrophosphate → adenylic acid + phosphoric acid.

It therefore seems very probable indeed that the cells of muscle and of the electrical organ of *Torpedo* alike derive the energy for their activity from the same chemical sources through the same chemical mechanisms, a suggestion which harmonizes with the well-known parallel between the physiological and pharmacological behaviour of the tissues in question, and the fact that they are both derived from embryonic pre-muscular rudiments.

Needham, Needham, Baldwin and Yudkin[3] reported the presence in the jaw muscles of *Paracentrotus* of two phosphagens, believed to be the phosphoric acid compounds of creatine and arginine respectively. In view of the phylogenetic interest[4] of these results we have studied the behaviour of certain phosphorylated compounds in the presence of enzyme extracts, prepared from the jaw muscles of *Sphærechinus granularis*, and have been able to demonstrate the synthesis of two phosphagen-like compounds from creatine and arginine respectively. The first of these behaves exactly in the way expected of creatine phosphoric acid, and in view of the results already reported by Needham, Needham, Baldwin and Yudkin, is almost certainly that compound. The second, synthesized by the enzyme preparations from arginine, behaves, so far as we can determine, like arginine phosphoric acid. Its hydrolysis is considerably retarded by molybdate, and the base liberated by the hydrolysis gives the Sakaguchi reaction and, when submitted to the action of arginase prepared from rabbit liver, gives quantitative yields of urea.

All the evidence we have obtained confirms the existence in echinoid jaw muscle of enzymes analogous to, if not identical with, those found in the muscles of other organisms and, as reported above, in the electrical organ of *Torpedo*, and we have found no reason to suppose that the mechanisms involved in the synthesis of the two phosphagens differ essentially from those demonstrated in vertebrate muscle by the Parnas school[5] and Needham and van Heyningen[6], and in arthropod muscle by Lehmann[7].

This confirmation of our earlier results makes us feel justified in laying considerably more emphasis than hitherto upon the phylogenetic significance of these purely biochemical results.

ERNEST BALDWIN.
DOROTHY MOYLE NEEDHAM.

Station Maritime de Biologie,
Tamaris-sur-Mer,
Var, France.
August 15.

[1] Kisch, *Biochem. Z.*, **225**, 183 (1930).
[2] Baldwin, *J. Exp. Biol.*, **10**, 222 (1933).
[3] Needham, Needham, Baldwin and Yudkin, *Proc. Roy. Soc.*, B, **110**, 260 (1932).
[4] Needham and Needham, *Sci. Progress*, **104**, 626 (1932).
[5] Parnas, V^e Congrès de Chimie Biologique, Bruxelles (1935).
[6] Needham and van Heyningen, NATURE, **135**, 585 (1935).
[7] Lehmann, *Biochem. Z.*, **281**, 271 (1935).

## Swarming of the Males of Certain European Anophelines in Captivity

THE study of the biology of the European *Anopheles*, particularly the complex of forms known as *Anopheles maculipennis*, has been greatly hampered by the difficulty of inducing mating under laboratory conditions. Missiroli and I[1] have given a summary of the experiments made with these mosquitoes, of which only the 'race' known as *atroparvus* has mated in captivity. In this form, it appears that there is no sexual dance on the part of the males as a preliminary to mating. Curiously

enough, females of all the races will mate with *atroparvus* males, but repeated attempts on the part of many investigators to get them to pair with males of their own kind have failed.

Some years ago, I constructed a large cage of wire netting, 10·5 metres long, 5 metres wide, and 6·2 metres high, in connexion with the malaria laboratory in Albania. The cage was designed for the observation of the behaviour of *maculipennis*, and an attempt was made to make the conditions within the enclosed area as natural as possible. A cement pool, a stable, a small laboratory, and a tree were included within the cage. Fertile *typicus* eggs were found in the pool in 1934, but in small numbers compared with the quantity of mosquitoes released, and no sexual activity was observed in the cage. Between June 19 and July 12, 1936, we released in the cage 4,500 adults of *typicus* bred from the egg, and on July 7 we first observed swarming of the males, although larvæ had been found in the pool some days previously. Since then we have found the males swarming almost every evening, the swarm usually starting between 7.15 and 7.30 p.m., and the principal swarm always forming in the same position : about half a metre beneath the top of the cage, directly under one of the cross beams, and about half a metre from one of the upright poles supporting the side. This orientation, under the cross beam, seems very curious, and we should consider it to be fortuitous were it not repeated so frequently.

The wire cage is, of course, completely open to external stimuli, and we have been carrying on some experiments in the opposite direction : in a room insulated so far as possible from external stimuli, so that all the reactions of the mosquitoes would be to factors within the room. The room used is 2·5 metres long, 2·3 metres wide and 2·6 metres high. It is constructed of mud brick, with an air space between the ceiling and the roof ; the windows are kept closed and have been covered on the outside with canvas curtains, so that the maximum light during the day is only about five foot-candles. The climate within the room remains remarkably constant, the temperature showing a diurnal fluctuation of about 5° around a mean of 20°, the humidity varying between 84 and 94 per cent. We released in this room about a thousand *maculipennis* adults bred from *typicus* eggs, but we did not observe any sexual activity, and we only obtained two batches of fertile $F_2$ eggs. At the same time, about 600 *Anopheles superpictus* were released in the room, and the males of this species were found to swarm under these conditions very readily, and numerous fertile *superpictus* eggs were found in the aquarium in the room. Up to July 27 we had released in the same room about 500 *Anopheles elutus*, raised in the laboratory. The males were first observed swarming on July 28, and afterwards batches of fertile eggs were found in the aquarium.

We are thus able to observe under varying conditions the sexual activities of the three malaria vectors of Europe. A few *bifurcatus* were also released in this room, and one evening four or five males were observed forming a swarm, and fertile eggs of this species were afterwards obtained.

L. W. HACKETT.
MARSTON BATES.

Seksioni Antimalarik,
Tirana, Albania.
August 1.

[1] *Rivista di Malariologia*, 14, 45 (1935).

## Persistence of the Eel-Grass Disease and Parasite on the American Atlantic Coast

EARLY in the summer, through facilities extended by Mr. John Lynch, of the U.S. Biological Survey, I was able to make a number of investigations of the existing eel-grass beds along the middle Atlantic coast, in the range of Cape Cod, Massachusetts, to Barnegat Bay, New Jersey. Mr. Lynch also supplied me with systematically taken specimens from beds farther north and south, Casco Bay, Maine, to Chesapeake Bay, Maryland, and with repeated observations from a number of points between. These studies were undertaken to discover to what extent the increasing number of optimistic reports concerning new and larger beds might indicate an effective return of the plant. For the greater part such reports describe late spring growths, during the season of rapid vegetative development, and give no clue of the plant's ability to withstand conditions arising in the less favourable warmer months, when the parasitic *Labyrinthula* is most active, or of its value as winter food for migratory birds, a matter of practical concern.

At the time of the first survey, in early June, small scattered beds of eel-grass, varying in vigour, were found all along the coast so far south as the northern end of Barnegat Bay, and extensive beds of small-leafed growths were described in the eastern shore of Chesapeake Bay, where the latter was being used for packing material. Barnegat Bay and the Delaware coast were notably free from the plant, as were the relatively rocky bays of the Connecticut coast.

The shallow bays of Long Island, Rhode Island, and Massachusetts bore patchy beds often several acres in area, and these were underlaid by extensive mats of healthy stem stock. These beds could conceivably be of ecological value, especially those along Rhode Island and Massachusetts, where the leaves averaged a metre in length, and foliation was relatively dense.

In all beds studied some plants were in seed, and, I understand from Mr. Lynch, a large fraction in the beds south of Cape Cod are now seeding. Seeds have been produced early in the summer for the past three years. It is surprising, therefore, to find but few seedlings even among the scattered plants in what appear to be new beds. Most shoots can be traced back to stem stock one or two seasons old, not very vigorous stock as a rule. If the beds continue to propagate mainly from stem stock, progress will be slow, even under favourable conditions of competition with the parasite.

Symptoms of the wasting disease were present everywhere in June, but there seemed to be no correlation between density of growth and infestation. The wasting is now at its height, so that some beds, as in Great Bay, Long Island, have entirely disappeared.

Specimens from all beds visited were examined microscopically for the *Labyrinthula* described in NATURE last year, and with which confirmatory inoculation experiments have since been performed[1,2]. Without exception it was present and active in streaked or mottled leaves, and in many regions it had already caused considerable wasting.

If previous experience may be taken as an indication, the following seasonal sequence may be expected : Very slow winter growth of the *Zostera* with the *Labyrinthula* passive in the leaves (the spindle form of the parasite has been found in winter specimens),

rapid vegetative development in the late spring, with slight increase in activity of the *Labyrinthula*, diminution in the vitality of the plant prior to seed formation in the early summer with sudden activation of the parasite, destruction of leaves, development of new leaf shoots and their subsequent destruction (repeated several times in mid-summer), and final exhaustion of a portion of the stem stock and dying back of part of the bed developed earlier. A number of plants will seed prematurely, or will appear to because more retarded members die off before the normal fruiting period is finished. Barring the development of resistent strains of *Zostera* or general attenuation of the parasite, this seems to be the probable cycle within any progressive return of the plant. This, I realize, is not a cheerful interpretation, but it will be recognized that readjustments no less drastic, but easily overlooked, occur constantly.

I should be grateful to readers of NATURE for particular information on local conditions of the eel-grass in England and on the Continent.

CHARLES E. RENN.

Woods Hole Oceanographic Institution,
Woods Hole, Massachusetts,
and
Harvard University,
Cambridge, Massachusetts.

[1] C. E. Renn, NATURE, 135, 544 (1935).
[2] C. E. Renn, *Biological Bulletin*, 70, 148 (1936).

### A Case of Complete Reversion of a Chromosomal Rearrangement in *Drosophila melanogaster*

THE process of gene mutation is known to be reversible, since back-mutations occur both spontaneously and under X-ray treatment. Yet no authenticated case of a complete reversal of a gene rearrangement has hitherto been observed. Muller and Stone[1] induced a partial re-inversion of the *ClB*-inversion of the *X*-chromosome, but neither of the new breaks corresponded to the original *ClB* breaks. A spontaneous re-inversion of the same inversion observed by Gershenson[2] has not been completely analysed; so it remains doubtful whether in this case old and new breaks coincided precisely.

In 1935, I described[3] a very long inversion of the *X*-chromosome induced by X-rays which was inseparably associated with a 'gene' for very rough eye-surface. In a stock homozygous for this inverted chromosome and carrying several recessive markers, animals with normal eye-surface appeared. Contamination was excluded by the fact that all the other factors were still present. A thorough genetical analysis showed that in these animals not only the rough eye-surface 'gene', but also the inversion had disappeared, and that old and new breaks were identical. This has since been checked up cytologically by my colleague, Mr. C. W. Emmens, in the salivary gland chromosomes.

The rough eye-surface associated with the inversion behaves allelomorphically with the factor roughest[3]. Genetical and cytological methods have hitherto failed to reveal any signs of a chromosomal abnormality associated with that mutant. Nevertheless, it remains still possible that roughest[3] is a position effect too minute to be demonstrable with our present methods.

This seems to be the first case in which a complete reversal of a gene rearrangement has been demonstrated by all available criteria. At the same time, the case furnishes crucial evidence for the existence of a position effect, since phenotypic effect and inversion appeared and disappeared simultaneously.

A detailed analysis of the case will be published in the *Journal of Genetics*.

HANS GRÜNEBERG.

Department of Zoology,
University College,
London.
Aug. 28.

[1] H. J. Muller and W. S. Stone, *Anat. Record*, 47 (1930).
[2] S. Gershenson, Drosophila Information Service, No. 1 (1934).
[3] Hans Grüneberg, *J. Genetics*, 31, 163 (1935).

### Different Results in Reciprocal Crosses between Diploid and Triploid *Allium Schœnoprasum* L.

IN the summer of 1934, crosses were made between diploid forms of chive ($2n=16$) and artificial triploids ($2n=24$)[1]. The somatic chromosome numbers in the progeny of these crosses have now been determined for 100 plants and are shown in the accompanying table.

The results exhibit a decided difference, according to whether the diploid or the triploid was used as the mother plant. In the former case, the majority of the progeny obtained were diploids, only 18 out of 71 plants having different chromosome numbers, namely, $2n=22$–$24$. In this cross the numbers 17–21 were not found at all. If, on the other hand, the triploid was used as the mother plant, all chromosome numbers between 16 and 24, except the number 20, were obtained. The trisome class, $2n=17$, which was not formed in the former case, was now the one most numerously represented. In addition, there also occurred one plant with 28 chromosomes, the result of the functioning of a giant gamete.

| Direction of cross | Chromosome number of the progeny | | | | | | | | | | Total of plants |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | Med. | |
| $2x$ ♀ × $3x$ ♂ | 53 | 0 | 0 | 0 | 0 | 0 | 4 | 11 | 3 | 17·8 | 71 |
| $3x$ ♀ × $2x$ ♂ | 8 | 9 | 1 | 2 | 0 | 4 | 1 | 2 | 2 | 18·5 | 29 |

It is obvious that the effect of the elimination or non-formation of aneuploid zygotes is greater when the embryo develops on a diploid than on a triploid plant.

These results are in agreement with earlier work on reciprocal crosses between diploids and triploids, for example, in *Oenothera*[2] and *Zea*[3].

ALBERT LEVAN.

Sugar-beet Research Station,
Hilleshög, Landskrona, Sweden.
July 23.

[1] Levan, *Hereditas*, 22, 1 (1936).
[2] van Overeem, *Beih. Bot. Zbl.*, 38, 73 (1921).
[3] McClintock, *Genetics*, 14, 180 (1929).

### The Feulgen Reaction of the Bacteriophage Substance

THREE years ago, a method was described which yielded pure preparations of a *Coli* bacteriophage of large particle size (*WLL*) in weighable quantities[1]. The high phosphorus content (3·7 per cent) of these preparations and their high affinity for basic dyes

suggested—in connexion with other analytical results—that the chief constituent of the particles was of nucleoproteid nature[2].

It has now been found that they are intensively stained by Feulgen's reagent, generally regarded as a histo-chemical reagent for thymonucleic acid. Bacteria and bacterial debris (even a concentrated preparation of debris of phage-size obtained by lysing the organism with the very small phage *S*13 which afterwards could be removed by washing) treated in the same way remain unstained. So the phage-substance seems to be chemically different from any constituent of the bacterial cell normally present in significant amount.

The concentrated and purified preparations of a *Staphylococcus* phage obtained recently by Dr. Elford show exactly the same staining reactions as the *WLL-Coli*-phage.

M. SCHLESINGER.

National Institute for Medical Research,
London, N.W.3.
Aug. 8.

M. Schlesinger, *Biochem. Z.*, **264**, 6 (1933).
[2] M. Schlesinger, *Biochem. Z.*, **273**, 306 (1934).

## Lightning and Atmospherics

IN NATURE of August 15, on p. 278, I notice a paragraph dealing with atmospherics produced by lightning discharges. From my own observations, I would express the opinion that the statements made in that paragraph only represent a part of the complete picture. There are so many different kinds of atmospherics observed both aurally in radio receivers and visually when they are recorded as by means of cathode ray oscillographs, that a complete generalization in such simple terms as are there expressed is scarcely possible.

With certain classes of atmospherics, in some cases quite a prolonged crackling can be observed lasting as much as a second before the lightning flash is observed visually. In such instances the crackling, one can only presume, arises from initial priming discharges somewhat in the nature of long brushing streamers, such as may be observed with high-tension electrical test apparatus, which brushing ultimately culminates in a complete sparkover. In all cases of observed atmospherics of this nature, the crackling sound of more or less prolonged duration finishes with a loud crack coincident with the final sparkover, which is observed as the visible lightning flash.

This type of atmospheric is only observed with certain forms of thunderstorms and is by no means of general occurrence. In many cases the sounds heard are of a simple click nature, which corresponds to straight sparkover without the preliminary brushing discharges giving the prolonged crackling sounds.

So far as my own observations go, the type of atmospheric particularly referred to, which gives the long crackling noise followed by the final crack of the sparkover, is a much rarer form than the simpler types in which it is obvious that the sound accompanies the visual flash. It is possibly for this reason that little notice has been taken of this form of discharge.

PHILIP R. COURSEY.

67 Queens Road,
Richmond, Surrey.

## Colloid Substrate in Photosynthesis

IN an earlier note on this subject[1] it was recorded that in the interaction of two salts in an aqueous medium, leading to the formation of periodic structures (mineral arboreal growth), a colloidal condition is created in the medium, this state remaining stable under the original experimental conditions.

Since then, it has been observed that whilst periodic structures find their existence above the transition point of the colloid to the physico-chemical associations approaching double salts, the range of the colloid state is much wider, extending both above and below this transition point. Thus in the interaction of calcium chloride with sodium carbonate, arboreal growth appears above the hydrocalcite to calcite transition point, that is, at 10°–12°[2] with a range of formation of 10°–12°. But the systematic formation of the colloidal phase itself commences with the appearance of the gelatinous membrane at the interface of the two electrolytes at about 4°, and is produced regularly so long as this membrane exists.

Close observation showed that the colloid was not always confined to the aqueous medium. Very often it was also dispersed in the air above it. During the eruptions from the membrane-protuberances, effervescence on the surface of the liquid could be frequently observed, and by means of a narrow parallel beam of light from a Miller projecting lamp, the Brownian movement of finely divided colloidal matter could be seen in the space above the liquid. The evolution of this effect depended on such experimental conditions as osmotic pressure, height of column of liquid above membrane and character of membrane itself.

In the light of researches by Baly, Dhar and others on photosynthesis, these observations when applied to marine and atmospheric surroundings appear to have an important bearing upon natural phenomena. Details of this work are to be published elsewhere.

MAURICE COPISAROW.

145 Alexandra Road,
Manchester, 16.
Aug. 17.

[1] NATURE, **132**, 67 (1933).
[2] Copisarow, *J. Chem. Soc.*, **123**, 785 (1923).

## Indication of a Decrease in the Polarizability of a Non-Polar Molecule by Pressure

SOME years ago, results were published of measurements on the dielectric constant of carbon dioxide under pressures up to 1000 atm.[1]. Using Amagat's isotherm data, where available, the Clausius Mosotti function $P = \frac{\varepsilon - 1}{\varepsilon - 2} \times \frac{1}{d}$ was calculated; $P$ is proportional to the polarizability of the molecule. It was stated that $P$ showed a tendency to decrease, the decrease at 1000 atm. being about 1 per cent. It was considered not impossible at that time that this decrease was due to an uncertainty in the density $d$.

Lately more accurate isotherms of carbon dioxide have been published[2]. Using these data, the value of $P$ has been recalculated. As an example of the results, values of $P$ have been plotted in Fig. 1 against density, and in Fig. 2 against pressure. It can be seen that $P$ decreases with pressure and this

decrease is obviously more simply related with the change in pressure than with the change in density.

There are two possibilities to account for this effect. The first is, that the Clausius Mosotti expression is not the exact relation between the polarizability of the molecules and the dielectric constant; the second one is, that the polarizability of a molecule is really decreased by pressure. With regard to the first possibility, it must be remembered that a rigorous proof of the Clausius Mosotti expression has not yet been given, and it is possible that the assumptions necessary to arrive at the formula do not hold under the present conditions. From the way in which the formula is deduced, and from a recent discussion by Darwin[3], it can be expected that, if corrections to the simple Clausius Mosotti expression are necessary at higher densities, these will be functions of density, which will not strongly depend on temperature. This view is, however, in contradiction with the experimental data.

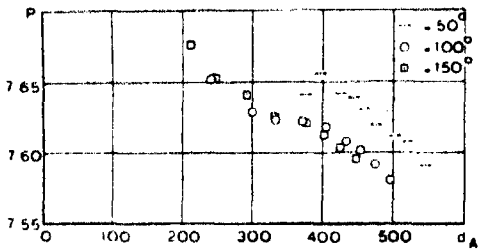


FIG. 1.

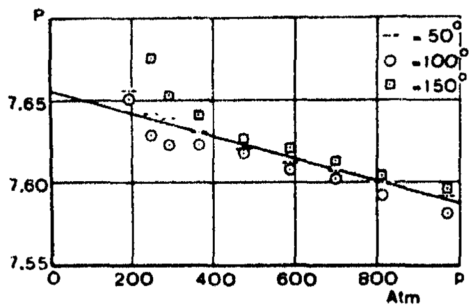


FIG. 2.

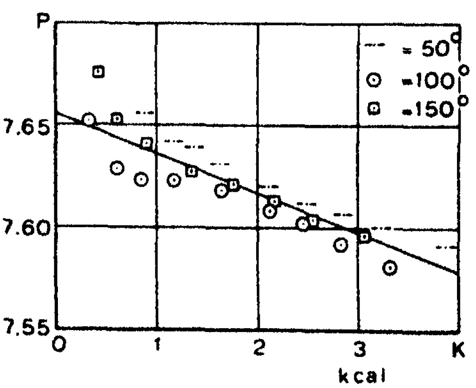


FIG. 3.

In favour of the second possibility, an argument can be given making use of the virial theorem. If the constituent parts of the molecule, that is, nuclei and electrons, are treated as separate particles, all the forces acting between those particles are Coulomb forces. The virial theorem applied to such a system leads to

$$3\triangle pv = \triangle K + \triangle U^{4},$$

where $pv$ is the product of pressure and volume, $U$ is the total energy of the system, and $K$ is the sum of the kinetic energies of all particles. For an isothermal compression the kinetic energy of the molecules (for example, translational and rotational) is constant by the equipartition law. Therefore $\triangle K$ measures the increase of the kinetic energy of the internal motion of the molecules (for example, kinetic energy of nuclear vibrations and electronic motion) and can be considered as a useful measure of any alteration inside the molecule, caused by compression. It is, therefore, apparent that a relation between $\triangle K$ and $P$ must be sought.

In the case of carbon dioxide, $\triangle K$—which can be calculated from isotherm data—amounts to 3·5 kgm. cal./mol. at 1000 atm., or 0·15 e.v. per molecule. It changes almost linearly with $p$, and is affected only slightly by temperature. The simple relation found between $P$ and pressure therefore points to a similar relation between $P$ and $\triangle K$. In Fig. 3, $P$ is plotted as a function of $\triangle K$, for three sets of measurements at different temperatures, and it can be seen that, within the experimental accuracy, $P$ is a linear function of $\triangle K$. (The uncertainty in $P$ is estimated as $\pm$ 0·03 at density 200 A.; $\pm$ 0·015 at 400 A.; $\pm$ 0·01 at 600 A.)

A. MICHELS.
C. MICHELS-VERAART.
A. BIJL.

v. d. Waals Laboratory,
The University,
Amsterdam.

[1] Michels and Michels, *Phil. Trans.*, A, **231**, 587 (1933).
[2] Michels and Michels, *Proc. Roy. Soc.*, A, **153**, 201 (1935).
[3] C. G. Darwin, *Proc. Roy. Soc.*, A, **146**, 17 (1934).
[4] W. Schottky, *Phys. Z.*, **21**, 232 (1920); J. C. Slater, *J. Chem. Phys.*, **1**, 691 (1933).

## Excitation of Raman Spectra of Substances with the aid of 'Optical Catalysers'

IN a recent paper[1], we have shown that the infra-red frequencies of glass can be calculated by taking the wave-lengths of the maxima of absorption bands of didymium glass as the incident exciting radiations, and those of the maxima of the fluorescent bands of the same glass excited by sunlight, as the Raman lines. The values thus obtained are in excellent agreement with those obtained for glass by the usual method of experimentation using a mercury lamp and many hours of exposure.

Following the same method of experimentation, we have now extended our observations to water, methyl alcohol, ethyl alcohol, acetone, pyridine and nitric acid solution in water. In order to produce absorption bands in these media, a trace of potassium permanganate was added to each of the above substances. The corresponding fluorescent bands obtained with sunlight were photographed. The duration of exposure varied, from two to three hours giving sufficiently strong bands on development of the plate. From the wave-lengths corresponding to the maxima of absorption and fluorescent bands as located by microphotometric records for each material, Raman shifts have been calculated which

represent both fundamental and combination frequencies. It is interesting to point out in this connexion that combination frequencies calculated in this way, when not in agreement with the values of previous workers, can still be built up either entirely with their values or jointly with our own.

The importance of this new technique for the study of Raman spectra lies in two directions. First, with the use of sunlight the time of exposure is considerably cut down, so that very faint lines can also be brought out; secondly, small shifts of faint Raman lines, which generally are masked by the strong incident spectrum, can be calculated.

Since the minute traces of potassium permanganate used to produce the absorption bands in the various substances do not seem to affect their modes of vibration concerned in the Raman effect, their action and that of didymium salts in glass may very appropriately be referred to as 'optically catalytic'. Workers on the Raman spectra of glass have also noted previously that small quantities of metallic oxides present in different varieties of glass do not alter their Raman lines.

There are other points connected with the method which throw an interesting light on the nature of the relations observed. For example, the work of Merton[2] and Taylor[3] on the absorption bands of solutions of potassium permanganate in different solvents shows that the differences of wave numbers between successive bands, for any solution, are not really constant, although their mean value is usually taken to represent the frequency of the $MnO_4$ ion as affected by the particular medium of the solvent. On the view taken in this paper, these discrepancies between the differences of wave numbers of the successive absorption bands are real, and are due to the fact that the actual positions of the absorption bands are conditioned by the appearance of Raman lines representing either fundamental or certain combination frequencies of the solvent medium, at certain definite wave-lengths constituting the fluorescent spectra of the substance under examination.

No results are given here as they would occupy too much space. They will be published with full experimental details elsewhere shortly.

K. PROSAD.
D. K. BHATTACHARYA.

Physics Department,
Science College,
Patna.
Aug 11.

[1] *Z. Phys.*, 98, 324 (1935).
[2] *Trans. Chem. Soc.*, 99, 637 (1911).
[3] "Molecular Spectra and Molecular Structure", Faraday Soc. Disc. No. 790, pp. 860–63 (1929).

## Points from Foregoing Letters

THE first quantitative measurements of the abundances of the elements in the planetary nebulæ are derived by Mr. T. L. Page from the intensities of 'forbidden' lines in the spectra of these objects. An explanation is sought for the surprisingly high abundance of neon and argon relative to oxygen, as compared with their proportions in the composition of the earth.

A variety of radioactive bromine has been detected, by Dr. C. H. Johnson and F. T. Hamblin, which possesses a half-period of some twenty-four hours. The authors consider that it is either an activated bromine nucleus or a new isotope.

The absorption of neutrons (belonging to Fermi's group C) by boron and by cadmium at ordinary and at low temperatures has been determined by a group of investigators from the Ukrainian Physico-Technical Institute. They conclude that the absorption curve of cadmium has a selective character. The results for boron do not agree with the 'inverse velocity law', but that may be due to a deviation of the silver detector from the $1/v$ relation.

G. L. Mack writes that he has failed to confirm the increase of ascorbic acid (vitamin C) when cabbage is boiled, as reported by Guha and Pal. The amount, he says, is no greater than that obtained by alcohol extraction or after treatment with hydrogen sulphide. The author concludes that practically all the apparent increase is due to the inactivation of an oxidizing enzyme, and not to the hydrolysis of an ascorbic acid ester.

E. Baldwin and Dr. D. M. Needham find that the electrical tissue of the ray, *Torpedo*, contains enzymes analogous to those found in the muscular tissue of that fish, and also in the jaw-muscle of the sea-urchin, *Sphærechinus granularis*. They deduce that both muscle and electrical organ derive their energy from the same chemical sources and through the same chemical mechanism.

In a stock of fruit-flies with very rough eye surface, accompanied by an inversion in the $X$-chromosome (originally induced by X-rays), Dr. H. Grüneberg has observed the appearance of animals with normal eye surface and without chromosome inversion. This is claimed to be the first clearly demonstrated case of complete reversal of a gene rearrangement.

A. Levan reports that crosses between two strains of chive (*Allium Schœnoprasum*) containing 16 and 24 chromosomes respectively gave offspring containing mostly 16 chromosomes when the mother plant contained 16, while when the mother plant contained 24, the chromosome number in the offspring varied between 16 and 24 (except 20), the most frequent being 17.

Dr. M. Schlesinger finds that his pure bacteriophage preparations are intensively stained by Feulgen's reagent, whilst bacteria and bacterial debris treated in the same way remain unstained.

Graphs showing the relation between the Clausius Mosotti function, $P$ (proportional to the polarizability of the molecule) and the density, the pressure and the change in kinetic energy of the internal motion of the molecules, $\Delta K$, are given by Prof. A. Michels, C. Michels-Veraart and A. Bijl, from calculations based upon recent data for carbon dioxide. They find a nearly linear relation between the polarizability and the pressure, also between polarizability and $\Delta K$.

Previous work of Prof. K. Prosad and D. K. Bhattacharya on didymium glass, of which the wave-lengths of absorption bands were taken as the incident exciting lines for the study of the Raman spectra of glass with very satisfactory results, has now been extended to a number of organic liquids and to nitric acid solution. Absorption bands in these liquids were produced by adding traces of potassium permanganate.

# Research Items

## Asianic Deities in the Paganism of Ancient Georgia

A RE-EXAMINATION of the evidence relating to Paganism in early Georgia by Prof. M. Tseretelli (*Georgica*, 1, 1) indicates the need for revision of hitherto accepted views, and the recognition of a considerable Asianic element in the ancient cults of the Caucasian area. The deities enumerated in the sources are Armaz Zaden, Ga or Gaïm and the Chaldean goddess It'rujan, or It'rushana. The resemblance of Armaz to Ahura-Mazda, together with the fact that Mazdaism was introduced into Georgia long before Christianity, suggests an obvious identification. There is no doubt that Armaz is a Georgian national deity. The account of the copper idol and the religious festival of Armaz given by St. Nina point to identification with Teshub, the god of the Mitanni and Urartaeans, the pre-Indo-European people of Armenia, who is represented with thunderbolt and axe, and may be related to Zeus Labraunda and Jupiter Maximus Dolichenus, *natus ubi ferrum exoritur*, whose worship was said to have been brought to Kommagene by Khalybean smiths. The god Zaden with Armaz gives rain and fertility to the Georgian soil. He is, in fact, the Asianic god of fertility, Sandar or Marduk, the Babylonian Tamūs. The custom of offering first fruits and the first born of man and beast to Zadin is probably Semitic. Human sacrifice was also offered to Ga and Gatsi. It is argued that Gatsi and Ga are the 'father' and 'mother' of the widespread fertility cult. A deity not mentioned in the texts, the goddess Ašhara, is still worshipped among the Abkhasians. She may be the goddess Išhara, mentioned in the Boghazhoī texts, who was also worshipped in Babylon, Assyria and Elam. She is the tutelary goddess of the homestead, and the mountaineers still worship "the angel of the house". Finally, there is the Chaldean goddess It'rujan who is opposed to Armaz. It'ru is rightly identified with Ishtar; 'jan' is probably Samain, the goddess of heaven, who as a Chaldean deity destroyed the idol of Armaz and was resisted by the natives. There is also evidence of a tree and pillar cult.

## Antiquities in Shetland

A TOUR of archæological investigation in Shetland made by Mr. Ludovic Man in July last, following up a similar investigation in Orkney last year, has produced some interesting results. An examination of the glacial clays and derived gravels produced a number of rolled stone implements of types similar to those of the palæolithic cultures of England and France. At Bressay an old land surface about three feet below the existing surface yielded more than a hundred tools, mostly of quartz and quartzite and of small dimensions, unrolled with sharp edges, which Mr. Man classifies as mesolithic. On Ward Hill at Sumburgh, a settlement of considerable size has been exposed by wind erosion. Stone foundations of a large number of buildings have been bared. The walls appear to have been three feet thick at the base, and the oval internal chamber some fifteen feet by ten feet in dimensions. No traces of superstructure survive; but stone implements, the half of a large saddle quern, and a massive hammer-stone, weighing thirty pounds, point to a considerable antiquity. Possible evidence of cultivation is found in small cleared plots, thirty feet in diameter, with the stones from the clearing lying without system on the periphery—it may be a prehistoric anticipation of the present method of cultivation in walled enclosures. The most interesting find, however, was at Braewick, where storm water had breached an 'ayr', or storm beach, and drained a small lock, exposing ancient timbers, in which the distinctive character of the nails, and the wooden pegs with hexagonal shafts, point to a Viking origin. If further examination of the material, which is now in Glasgow, confirms Mr. Man's conclusion that this is part of a Norse boat, it is the first find of that kind to be recorded in Scotland.

## Fossil Horse Remains from Idaho

NORTH AMERICA has supplied in its remains of fossil horses one of the most complete of evolutionary series. The collection of bones described by C. Lewis Gazin, from the Hagerman lake beds of Idaho, belonging to the Upper Pliocene, contains an abundant assortment of remains of *Plesippus shoshonensis*, an advanced member of its genus bordering on the horse types of the Pleistocene age (*Proc. U.S. Nat. Mus.*, 83, No. 2985, 281, Washington 1936). The material included 130 skulls of the species named above, and a large quantity of other skeletal material, some of which was found still in a position of articulation. The appearances are that the remains accumulated naturally round a water-hole, for amongst the many other vertebrates which are represented in the Hagerman beds there is a noticeably large number of aquatic forms. The paper contains descriptions, measurements, and comparative comments upon the horse remains.

## Urethral Sinus in Rodents and Insectivores

THE male of certain rodents and insectivores possesses a sac-like diverticulum of the urethra, the urethral sinus. The development of this structure in the white mouse and its occurrence in other forms have been dealt with by Hall (*J. Anat.*, 70, Pt. 3, 1936). The sinus makes its appearance about the sixteenth or seventeenth day. At this time, the fusion of the genital folds gives rise to the penile or secondary urethra, and the sinus arises as a dorsolateral bulge at their point of junction, but is derived from the primary urethra. A pair of solid club-shaped structures then arise as buds from the urethral epithelium just at a point where the sinus bulge occurs; these are the rudiments of Cowper's glands, which in the adult open into the base of the urinary sinus. The walls of the sinus are similar in nature to those of the urethra, and contain glands, whereas the epithelium of the penile urethra is non-glandular. The presence of this urino-genital sinus is reported in *Evotomys glareolus*, *Microtus hirtus*, *Apodemus sylvaticus*, *Mus rattus*, *Cricetus auratus* and *Fiber* (that is, *Ondatra*) *zibethicus*. It is apparently not present in *Cavia cobaya*.

### Loose Smut of Oats

THE fungus *Ustilago Avenæ*, causing loose smut of oats, is capable of infecting its host through the stigma of the flower, and the disease may also appear from later infection. A paper by Mr. Robert McKay ("Methods of Infection of Oat Grain with Ustilago Avenæ and the Influence of External Factors on the Incidence of the Disease", *Sci. Proc. Roy. Dub. Soc.*, **21**, No. 33, July 1936) shows that under the conditions of the crop in Ireland, the fungus produces a resting mycelium within the glumes, and further spores may also lodge there. These remain ungerminated until the following spring. Experiments on washing flower-infected grain in water, and on removing the glumes (de-hulling), both gave a substantial reduction of infection in the subsequent crop. A combination of these two methods of treatment resulted in almost complete control of the disease, and suggests that most of the infection is brought about by the ungerminated spores lodging within the glumes.

### Immunity of Apples to Woolly Aphis

IN certain countries the use of immune stocks and stems on which desirable varieties are grafted has met with considerable success as a means of combating attacks of woolly aphis (*Eriosoma Lanigerum*). An attempt to elucidate the underlying causes of resistance and immunity to this pest is described by M. B. Crane *et al.* (*J. Pom. and Hort. Sci.*, **14**, 2, 137; 1936). Its life-cycle is outlined, and preliminary experiments on the physiological aspect of immunity described. These suggest that the mechanical structure of the stem and the presence of certain insoluble substances may possibly be related to resistance, though they do not explain complete immunity. A genetical analysis was made by crossing a large number of common apple varieties with a number of well-known susceptible and immune rootstock varieties and testing the resultant seedlings for resistance or immunity. The results of this analysis indicate that "the hereditary behaviour of immunity is determined by and dependent upon a certain balance of genetic factors and is governed by a number of genes, the action of which is in part complementary and in part cumulative". Several immune seedlings raised in this way are being tested for their suitability for general use in respect to vigour, ease of propagation and productivity.

### Diorites of the Cascade Range, Oregon

A SERIES of dioritic intrusions penetrate Tertiary volcanic rocks in a narrow belt which extends longitudinally through the Cascade Range of Oregon. An interesting regional study of these rocks and the associated metasomatism and metamorphism has been made by A. F. Buddington and E. Callaghan (*Amer. J. Sci.*, 421–449; 1936). The intrusions are mostly dyke-like, but there are numerous plugs and a few small stocks. The rock-types represented range from augite-diorite to granodiorite and porphyritic dacite. Replacement of plagioclase by orthoclase is a common feature throughout. Similar orthoclasization, described by Gillson, transformed a gabbro into quartz-monzonite (Pioche, Nevada) and was ascribed by him to the action of potash-bearing emanations from below during the magmatic stage and also, locally, after solidification. The Cascade rocks are shown to be closely related chemically to those of the Mesozoic intrusives of the Sierra Nevada. Volcanic rocks surrounding the intrusions have been modified through zones varying in width from a few inches to nearly half a mile. In places the original rocks (basalt-andesite-rhyolite series) have been wholly reconstituted and changed to tourmaline-hornfels.

### The Patwar Meteorite, 1935

IT has been estimated that the number of meteorites recovered, after their fall to the earth's surface has been actually seen, averages about four per year since the year 1850. A large proportion of these meteorites are stones or masses of crystalline rock, a much smaller proportion being composed of metallic iron alloyed with nickel and cobalt. An account of the "Patwar Meteoric Shower of 29th July, 1935", by Dr. A. L. Coulson (*Rec. Geol. Surv. India*, **69**, 439), illustrates the considerable amount of careful work required to ascertain the circumstances of the fall of a meteorite, the recovery of its various parts, and the subsequent mineralogical and chemical analyses. Reports collected from the Tippera district of Bengal indicate that the Patwar meteorite fell on July 29, 1935, at $14^h$ $20^m$ Indian Standard Time. Its fall was accompanied by the usual phenomena of light and sound. Five portions of the meteorite were recovered over an area of about 4½ square miles. The largest portion, weighing 23 kgm., which came from Patwar, had penetrated the ground, presumably soft owing to monsoon conditions, to a depth of 34 inches. This portion, which is completely illustrated in the report by a number of photographs, has a greatest circumference of 2 ft. 9½ in.; its greatest length is 1 ft.; its breadth 10 in. and its thickness 8½ in. The specific gravity of the meteorite is 4·21. Analysis shows that the meteorite, which is intermediate in composition between a stone and an iron, is composed chiefly of nickel-iron, with olivine, enstatite and bytownite, together with smaller amounts of other compounds including hydrocarbons.

### Absorption of Short X-rays

T. R. Cuykendall and M. T. Jones have recently described (*Phys. Rev.*, **50**, 105) absorption experiments on X-rays from a 600 k.v. tube. A double crystal spectrometer was used to isolate X-ray beams of wave-length down to 40 X.U. The absorption of very short X-rays by carbon was in excellent agreement with the Klein-Nishina scattering formula. The absorption coefficients for a number of elements, heavy and light, were determined, and the photo-electric part of the absorption fitted to an empirical formula. The photo-electric absorption observed in lead in this frequency region is about 10 per cent higher than that calculated theoretically by Hulme and others.

### Mass-spectrographs

IN an article on "Second Order Focusing for Mass Spectrographs" (*Proc. Camb. Phil. Soc.*, **32**, pt. 3) Mr. W. W. Sawyer considers the conditions under which focusing may be improved when, instead of the electrostatic deviation being produced by the field between parallel plates, the field between co-axial cylindrical plates with the axis perpendicular to the plane traversed by the charged particles is substituted. The mean path of the particles in this field is nearly a concentric circle, and on emergence they enter a magnetic field the lines of which are parallel to the axis of the cylinders and the section

of which is a circle. The advantages of this arrangement were mentioned by Dr. F. W. Aston in a recent note in NATURE (137, 357; 1936). Mr. Sawyer gives the dimensions of the spectrograph constructed on these lines as follows: mean radius of cylinders 40 cm.; angle subtended at the axis ½ radian; distance from farther edge of electrostatic to near edge of magnetic field 15 cm.; diameter of magnetic field 15 cm.; the near edge of the photographic plate is 11·3 cm. beyond the farther edge of the magnetic field and 16·2 cm. from the axis of the beam between the two fields; and the plate itself is inclined at 24° to this axis.

### Resolution of an Allene Compound

THE prediction that optical activity could be exhibited by allenes of the general type

$$\begin{matrix} a \\ b \end{matrix}\!\!>C = C = C<\!\!\begin{matrix} c \\ d \end{matrix}$$

was made by van't Hoff in 1875 ("La Chimie dans l'Espace", p. 29) and many unsuccessful attempts were made to verify it. The linking of the central carbon atom in the triad differs considerably from those types for which the tetrahedral theory has been shown to hold. The groups $a$ and $c$ and $b$ and $d$ may be identical. P. M. Raitland and W. H. Mills (*J. Chem. Soc.*, 987; 1936) have now shown that the compound in which $a = d = C_6H_5 = \varphi$ (phenyl) and $b = c = C_{10}H_7$ (naphthyl), when produced by the catalytic dehydration of the alcohol:

$$\begin{matrix} \varphi \\ C_{10}H_7 \end{matrix}\!\!>C(OH).CH:C<\!\!\begin{matrix} C_{10}H_7 \\ \varphi \end{matrix} = H_2O + \begin{matrix} \varphi \\ C_{10}H_7 \end{matrix}\!\!>C:C:C<\!\!\begin{matrix} C_{10}H_7 \\ \varphi \end{matrix}$$

by means of optically active catalysts, can be obtained in two entiomorphous forms. As catalysts, *d*- and *l*-camphor sulphonic acids were used in benzene solution. The specific rotation $[\alpha]_{5461}$ of the active allene has the large value of 437°–438°. The two forms (m.p. 158°–159°) combined in solution in ether to a racemic compound (m.p. 242°–244°). Van't Hoff's prediction of the enantiomorphism of unsymmetrically substituted allenes is thus verified. It depends on the assumptions of the linear arrangement of the three carbon atoms and the disposition of the external valencies of the terminal carbon atoms in planes at right angles to one another.

### The Marconi-E.M.I. Television System

ON the occasion of the recent demonstrations of television provided in connexion with the Radio Exhibition at Olympia, the programmes were transmitted on alternate days by the Baird system and by the Marconi-E.M.I. system. Some details of the latter system are given in an illustrated pamphlet just issued by the Marconi-E.M.I. Television Co., Ltd. The system employs one or more 'Emitron' scanning cameras, having no moving parts, by means of which the scenes to be transmitted are directly and continuously transformed into electrical impulses without the intermediary of a film device. These cameras can be used under normal conditions of daylight on exterior locations or in studios. Film scanning cameras are also included in the normal equipment. In either case, the resulting electrical impulses are fed to a specially developed modulator unit, whence the oscillations of the main transmitter are controlled. A suitable synchronizing signal is included in the transmissions by means of which complete steadiness of the received picture is ensured. The pictures are transmitted at a frequency of 25 per second with a scanning detail of 405, 240 or 120 lines, and provision is made in the equipment for either straight or interlaced scanning. The latter system is recommended since flicker of the received picture is entirely eliminated. The radio transmitter consists essentially of a master oscillator, frequency doubler and amplifying and modulating equipment. With the carrier frequency in the region of 40 megacycles per second, it is claimed that the frequency can be maintained constant to an accuracy of ± 1 part in 20,000. The modulating stages are designed to have linear response from zero frequency up to 3 megacycles per second. The aerial system comprises a number of aerial and reflector units suspended round the periphery of an octagon; the whole system is designed to give maximum radiation in the horizontal plane, uniform in all directions. In the arrangement of the aerial system at the B.B.C. station at Alexandra Palace, the aerials for the sound and vision transmissions are erected one above the other on the same tower.

### Accuracy of Meteor Observations

WITHIN recent months, three independent articles have appeared in different journals dealing with this subject. Mr. B. S. Whitney has published (*Mon. Not. R.A.S.*, 96, 5, March 1936) an interesting paper, "New Methods for Computing Meteor Heights", in which it is admitted that meteor heights deduced from ordinary visual observations are subject to large errors because of the difficulty in observing and plotting the paths accurately. He proceeds to develop a method for adjusting the beginning and ending as seen at different stations, the adjustments being the smallest possible which will refer the recorded directions to a common point. In the case of multiply observed meteors or fireballs a least square solution is developed, and three cases have been already computed by the method by the staff of Flower Observatory of the University of Pennsylvania, where the author is engaged in research. Unfortunately, the numerical results are not given, so it is impossible to judge the extent of the observational errors. In *Popular Astronomy* of May 1936 there is an article by Messrs. F. Watson, jun., and E. M. Cook, entitled "The Accuracy of Observations by Inexperienced Meteor Observers", in which some rather startling conclusions are drawn from the results of observational tests. It appears that in the case of inexperienced observers, the probable error in the direction of a meteor lies between ± 10·8° and ± 18·8°. Experienced observers, however, concentrating on bright meteors, have reported observational errors as low as ± 4°. The Rev. Dr. M. Davidson (*J. Brit. Ast. Assoc.*, 46, 8, June 1936) has given a very comprehensive analysis of the method which he proposes for computing real paths, assuming the *direction* of flight to be accurately recorded, but allowing for the beginning or ending of the apparent path to be missed. In this article, "The Computation of the Real Paths of Meteors", two numerical examples are fully worked out, and it is shown that in both cases a considerable portion of the flight was missed by one or other observer. These papers suggest that the whole subject of meteor observation may require reconsideration in order that more accurate results may be obtained.

# Science and Electric Lighting

A POPULAR discourse at the Blackpool meeting of the British Association was given on Friday, September 11, by Mr. C. C. Paterson. He chose as his subject "Science and Electric Lighting", and illustrated his discourse by many striking and spectacular experiments. Through the medium of these experiments, he enabled the audience to picture the present outlook of the scientific worker in the field of electric lighting and how rapidly it is changing. During the last four years, the amount of light that can be obtained from a given quantity of electricity has been increased three times. During this time, it has also been demonstrated that it is possible to make lamps of which the luminous component is at least a hundred times brighter than the brightest filament previously available. These great achievements are rapidly being exploited by industry in Great Britain.

Mr. Paterson began by showing the fundamentally different methods of producing electric light by filament lamps and discharge lamps. In one we obtain light from solids and in the other from vapours. In the latter kind of lamp, the light comes from vapour made brilliantly luminous by passing electricity through it. He showed a lamp with a container for a small quantity of vapour having a volume of about a twentieth of a cubic inch. Success followed research when it was found how to pass a current through this little enclosure. The difficulty was to make the free molecules of the vapour carry electricity, but once the current started it was difficult to control it. The intensity of the light in this lamp is a measure of the vigour with which the molecules of vapour respond to the stimulation. The molecules of different vapours respond in different ways, and they show their peculiarities by the nature of the light they emit. By the spectrograph, this light can be separated into its various components, and from the point of view of the lamp maker these specify the lamp.

In the incandescent filament lamp, the filament of which is now made of tungsten, and is heated to a very high temperature, the molecules of the solid tungsten do not radiate light in the same way as vapour molecules. This is shown by the fact that the spectrum of this lamp contains all the colours shaded into one another. The spectrum of any incandescent solid or liquid is always of this type. This follows because the molecules cannot move as if they were in free space; they are constrained by the neighbouring molecules. Their light is very similar to that of the sun, which comes from incandescent gases and vapours under extreme conditions of pressure. The light given by an incandescent filament being a rough imitation of sunlight satisfies our demands for illumination. Why therefore should we want to use something else? The reason is that the new lamps are able to give us much more light in comparison with the waste heat that is always produced.

With filament lamps the higher their temperature the more light they give, but the tungsten evaporates more rapidly the higher the temperature and thus its life is short. Research has discovered that if we coil the filament so that it occupies less space, the total convection currents will be less and the evaporation will be reduced. From this was developed the tightly coiled gas filament lamp which has been the most popular type of electric lamp for the last twenty years. In addition, by coiling the coil the efficiency can be still further increased. More than half the number of lamps now used in Great Britain for domestic purposes have coiled coil filaments and they give up to twenty per cent more light for the same consumption of electricity.

The metal tungsten out of which the filament is made is one of the toughest and most refractory of metals. It is so hard that it has to be drawn through diamond dies which have to be pierced with round holes no more than the size of a fine human hair. The wire diameter has to be correct to within 0·5 per cent, that is, five millionths of an inch. The craftsmanship of the girls who do this wire drawing is deserving of the highest praise. Mr. Paterson said that one of them described the process to him as like threading a wire you can't see through a hole that isn't there. This minute thread has then to be coiled with the greatest uniformity and equal precision, and finally the coil has to be again coiled. Out of the 3,775 turns in this spiral, not a single one must touch its neighbour, although the space between them is less than the thickness of a cigarette paper.

The enhanced efficiency of a vapour lamp is due to the absence of unwanted kinds of radiant rays. For mercury vapour lamps the effective light radiated is about three times as great for the same consumption of energy. If we had two electric lamps both using a pennyworth of electricity a day, but one giving only blue light and the other only green light, the latter appears to give more light than the former. The reason is that the green light is more useful to see with—in other words, it appears brighter. For this statement to be strictly correct, it has been presupposed that the blue light and the green light demand the same proportion of the electric power to produce them.

Tubular lamps were shown containing vapours of many kinds, and the difficulties of producing light of a satisfactory colour at a cheap rate were considered. The sodium lamp, which is the most economical, gives light of an unpleasing colour, and unfortunately no good way of correcting this colour defect has yet been invented. The neon lamp has been found very useful for floodlighting red brick buildings and for other colour effects. It is almost completely deficient in green and blue rays.

Mr. Paterson mentioned that some new investigations have opened out a new and very promising field of research. It has been discovered that if we coat the inside of a neon tube with a certain luminescent powder, the activity of the gas in the tube excites the characteristic fluorescence of this powder. It therefore gives out light of the colour we want, which, as it mixes with the red light from the neon gas, gives a series of pleasant colours very suitable for interior lighting. Hitherto it has only been found possible to excite fluorescence to an appreciable extent by direct excitation of the powder by the electrons of which the current consists, or else by means of the mercury discharge, which is very rich in ultra-violet lines. The great advance lies in the

discovery that neon, which is comparatively poor in ultra-violet light, can by using suitable powders be made to excite luminescence. These luminescent materials will probably be largely used in electric discharge lamp lighting. They will add the missing colours to light given out by vapours and gases, thus making objects illuminated by them appear as they do in daylight.

It was found four years ago that very great yields of light could be obtained from the passage of electricity through mercury vapour, if the pressure of the vapour was increased to about one atmosphere instead of using only one hundredth of an atmosphere as in the older types of lamp. This has led to the improved lighting of hundreds of miles of streets in Britain. There are now about 15,000 street lighting posts fitted with these lamps.

Light is becoming so cheap that it is foolish not to make full use of it. Its liberal use contributes greatly to safety. It enhances the beauty of our homes and increases the efficiency of our workshops. Gardens and highways at night can be made beautiful by its use. Blackpool, perhaps more than any other town, has improved its amenities by using artificial light. Incidentally, this gives a royal welcome to its visitors.

# Plant Hunting and Exploration in Tibet

THE second evening discourse at the Blackpool meeting of the British Association was delivered on September 15 by Capt. F. Kingdon-Ward. He said that however much we may regret some of the results of the industrialization of Britain—the destruction of forest, the urbanization of pasture land, slums, and so on—our country is in some respects a vast improvement on the England of four centuries ago. It was then a colourless land, especially during the winter. Thanks to the great interest taken in horticulture and sylviculture to-day, it is that no longer. About twelve thousand species of introduced trees, shrubs and herbs are cultivated in the open—nearly ten times the total number of flowering plants which occur wild. Thus the British climate must be singularly elastic, and the plants themselves highly adaptable. Probably in no other country in the world of equal area can so many alien plants be grown. Some are difficult, but more are easy, and not a few naturalize themselves.

Tibet, the highest plateau in the world, is not as is generally supposed a complete desert. There is a gradual increase in the flora from west to east, and from north to south, corresponding with the change in the physiographical nature of the country; the vegetation slowly changes from tundra to scrub and grassland, and from scrub to forest. Naturally, the most prolific and varied flora is found in the forested south-eastern region. This flora is a mixed one. The climate varies greatly from warm temperate at the bottom of the gorges where Tibet reaches its lowest altitude at 5,000 feet, to subarctic on the high snow-clad ranges the peaks of which attain 25,000 feet. All adjacent regions—China, Indo-Malaya, the Himalaya—have contributed to the flora of Tibet. Not every plant found there is hardy in Britain, but a surprising number are. Nor is it possible to forecast whether a given plant will be hardy or not; experience enables one to make a shrewd guess, but no more. On the whole, the plants which have proved most adaptable to our gardens are those which are not found growing under extreme conditions; that is to say, the plants, not of the tundra, nor of the deep forested river gorges, nor of the highest alpine ranges, but those of the intermediate scrub-clad plateau country, at 10,000–12,000 feet altitude.

Throughout the summer, one is busy collecting plants in flower. In late autumn, one starts harvesting seeds. It is not necessary to mark the plants when in flower, of which seed is required. Most plants are found over extensive areas where the climatic conditions are similar, and constant practise enables one to recognize a given plant by its fruits as readily as by its flowers. Particular plants occur in prodigious numbers; most species are at least common; the difficulty is to discover a rare plant! Capt. Kingdon-Ward said that he could recall very few of which he discovered but *one* specimen—*Leycesteria crocothyrros* is one of them.

Tibet has become famous as the land of the blue poppy (*Meconopsis betonicifolia*) and the scarlet creeping rhododendron (*R. repens*). But it is equally the home of many other beautiful flowers, as gentians, lilies, barberries, primulas and many more.

# Science at the International Peace Congress

SCIENTIFIC concern for the preservation of world peace found abundant expression at the International Peace Congress held at Brussels on September 3–6. Special commissions considered the bearing of art, science and letters, medicine, agriculture and education on the problems of peace and war, the report of the Science Sub-Commission, formed by a small but internationally representative body of scientific workers under the chairmanship of Dr. J. D. Bernal of Cambridge, being typical of the constructive attitude of the professional delegates.

This committee clearly recognized the effects of war in disintegrating the humane purpose and international character of science, and declared that scientific workers should do their utmost to strengthen international amity not only by a general determination to oppose war but also by definite practical activity. "We have to consider," it decided, "how we can best assist in preventing an immediate

outbreak of war, and in permanently removing its fundamental causes. The International Peace Campaign offers us the great opportunity of working effectively for both these ends." Stressing the importance of the radical approach, it added that scientific workers should co-operate "in the task of removing the causes of war by subjecting them to scientific and historical analyses and by exposing the theories of those who strive to excuse and justify war."

It was unanimously agreed, therefore, that a permanent Science Commission of the International Peace Campaign should be set up "with the general object of uniting all scientists in the struggle for peace". Its proposed activities include (1) the coordination of the work of the existing peace organizations of scientific workers and their extension to countries in which they do not exist; (2) the formation of joint commissions on (*a*) science and war and (*b*) the removal of the basic causes of war; (3) propaganda for a peace oath by all scientific workers and the incorporation of such a declaration in the oaths of those taking university degrees and diplomas; (4) concrete support for those scientific workers who are made to suffer for refusing to take part in research or other activities concerned with war.

The joint commission on science and war is to include chemists, physicists, engineers, aeroplane technicians, doctors, bacteriologists, geologists and military experts, who will endeavour (1) to study the technique of modern warfare and its probable effects on the military and civil populations; (2) to co-operate effectively in the international suppression of chemical and biological warfare; (3) to publish the results of its investigations promptly and clearly, without minimizing or exaggerating the dangers of modern war or seeking to claim an unobtainable accuracy; (4) to issue critical bibliographies on the technique of warfare and other special studies on this subject; (5) to impress on scientific workers themselves the part they are playing, directly or indirectly, in preparations for war, and to direct attention to the utilization for military purposes of funds intended for civil research and development; (6) to serve as an information bureau on technical military questions to all peace organizations.

The committee concerned with the fundamental causes of war is to include biologists, psychologists, anthropologists, medical men, sociologists, historians and economists, whose immediate task it will be to produce a concise statement on the causes of war and the ways in which men of science can help to eliminate them. It will also neglect no opportunity to expose pseudo-scientific and pseudo-historical theories used for war propaganda, such as those which postulate the biological necessity of war, the need for colonial expansion because of population pressure, the innate inequality of races, the degenerating effects of miscegenation, and so on. The regular work of this committee will therefore include (1) continuous propaganda in the scientific and popular press; (2) the exposure of subtle and direct war propaganda in schools and colleges; (3) appeals to learned societies and other organizations to defend scientific truth against distortion and unjustified rationalization; (4) the provision of study facilities by the publication of critical bibliographies and such other assistance as a central bureau can provide.

The translation of these objectives into effective practice will require considerable funds, organizational ability and individual support, but the success of the Peace Congress as a whole, combined with other evidence of a widespread appreciation of the duty and purpose of scientific endeavour, suggests that these essentials will not be lacking. They must not be if the lust for war is to be overcome by an organized will for peace. CEDRIC DOVER.

# Molluscs of Northern Asia

MR. ALAN MOZLEY, after several studies of the Mollusca of Canada, has recently made expeditions into Siberia and northern Kazakstan during the open seasons of the years 1932 and 1933, when typical areas in several of the great natural regions were examined in some detail, and extensive collections made with the object of obtaining fresh and accurate information regarding the constitution and distribution of the molluscan fauna ("The Freshwater and Terrestrial Mollusca of Northern Asia". *Trans. Roy. Soc. Edin.*, **58**, Part 3 (No. 24), 1935–36). The area covered includes the greater part of continental Asia to the north of latitude 50°, not including Outer Mongolia and Manchuria.

The aquatic species inhabit three types of water—ponds, lakes and streams. Of these the ponds and pond-like lakes only have an abundant molluscan fauna, and these are mostly hardy northern European species. Both the large lakes, which are uncommon, and the streams, usually present special conditions unfavourable to the molluscs. There is found to be a small group of circumboreal, a large number of Eurasian species, a few which are common to North America and north-eastern Asia, and several endemic forms. On the basis of these groups, Northern Asia may be divided into four faunal regions, the Great Siberian Region, the Baikal Region, the Far Eastern Region and the Chuckchee-Kamchatka Region.

In the northern part of Kazakstan and Southern Siberia there are numerous drainage basins in which the reservoirs are saline to a varying degree, the main salts being chlorides and sulphates which are detrimental to the molluscs. The presence of old shore lines round many of these indicates their greater extent during previous pluvial periods, fossil molluscs being found in some of these old shore-line deposits, in some cases the number of species decreasing in the descending series of beaches, giving evidence of a progressive decrease in molluscs. The species most tolerant of these conditions are *Planorbis planorbis* L., *Limnaea palustris saiidalensis* Mozley, and *Limnaea palustris Kazakensis* Mozley.

Temporary ponds formed by melting snow in spring are characteristic habitats in the steppe and forest steppe region both in Canada and Siberia, conditions of life being severe; but numbers of invertebrates manage to exist in them, including five species of molluscs in Northern Asia.

## Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor gives notice that the professorship of animal pathology will be vacated on September 30 by the resignation of Prof. J. B. Buxton.

The Board of Managers of the Frank Edward Elmore Fund have awarded studentships to A. C. E. Cole of Trinity College, G. D. Hadley of Clare College, L. C. Martin of Gonville and Caius College and B. McArdale. Dr. H. G. Booker of Christ's College has been appointed assistant lecturer in mathematics, and Mrs. J. V. Robinson of Girton College assistant lecturer in economics and politics.

Dr. T. S. Hele has resigned his University lectureship in biochemistry, H. W. Hall of St. John's College, W. A. Fell of Sidney Sussex and R. S. Handley of Gonville and Caius College their demonstratorships in anatomy, Dr. M. Born his lectureship in mathematics and T. C. Nicholas of Trinity College his lectureship in geology.

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COURSES in administration have hitherto been specialized or restricted to different fields of administration, such as industrial, business, public, military, colonial and agricultural administration and often with more emphasis on the adjective than the noun. In a recently issued prospectus, Mr. W. R. Dunlop gives a syllabus of a course in administration with no particular applicational bias, though permitting of such bias by the appropriate selection of illustrative cases and problems. The course embodies the principles and technique, the underlying subjects and the mental activity and art common to all administration. Special attention is given to the history of administration from early times and with special reference to policy and leadership. Administration in its wider sense of human purpose and method is held to be one of the primary objectives of general education, and Mr. Dunlop would like to see specific education for administration, or at least management, made part of our educational system. The prospectus is supplemented by appendixes describing the research work, connexions and experience on which these views and the course itself are based. Copies may be obtained on application in writing to Mr. W. R. Dunlop, 57 Gordon Square, London, W.C.1.

DR. ROSCOE POUND, dean of the Faculty of Law of Harvard University, spoke recently at a Graduate School Convocation in Brown University on "The Place of Higher Learning in American Life". The general tenor of Dr. Pound's thoughtful and stimulating address (*School and Society*, August 8) may be inferred from his remark that his topic might well have had for its title "Higher Learning as Insurance of American Institutions" coupled with his opinion that what is significant in those institutions is that they tend to safeguard opportunity for all, freedom, and the corollary of freedom, responsibility. One of the points he makes is in connexion with the enormous development in recent times of means of manipulating public opinion. "The methods of advertising, carried to the limits of psychological effectiveness in business, have been taken over into public affairs. . . . Even newspapers are being left behind by broadcasting. A proper functioning of democratic institutions calls for corresponding development of the means of resistance to this pressure, and the best guarantee of intelligent resistance is to be found in a general high level of learning".

SALESMANSHIP has long been recognized as a suitable subject of instruction in institutions of higher education in the United States. Recently the complementary science and art of shopping have received a good deal of attention, partly because the industrial depression has focused attention more urgently on the problem of how to get the most one can for one's dollar. At four regional conferences on home-economics education called by the United States Office of Education in 1934, this matter was a principal topic of discussion, and on the basis of material resulting from these and later conferences a pamphlet was prepared by specialists of that Office and published under the title "Consumer-buying in the Educational Program for Home-making: Suggestions for Teachers of Home-making in Secondary School and Adult Classes". Among the reasons given for education for buying are the enormous increase in the variety of commodities and services offered and the fact that price has become even less a guide to quality than it was formerly. The United States Government has been zealous in publishing masses of statistics bearing on the subject in the interest of consumers. Among them are numerous publications of the Department of Agriculture, including its food and drug administration. Such is the profusion of data that in July 1934 a special index to them was published under the title "Government Publications of Use to Consumers".

## Science News a Century Ago

### Lyell and Mantell

IN a letter to Mantell written on September 19, 1836, Lyell referred to John Fleming (1785–1857), the Presbyterian minister and naturalist, who "after several applications in vain for chairs more consistent with his zoological and botanical acquirements", had accepted the chair of natural philosophy at Aberdeen. This appointment, Lyell said, had given him no doubt "much fag to get up arrears of mathematical knowledge. But unfortunately, something worse than the lectures fell to his hard fate. Several University bills and a Royal Visitation caused tremendous secretarian or clerk's labour to fall on the Junior Professor who is obliged to serve as secretary to the University."

"You will see by this that you, my good friend," Lyell continued, "are not singular in finding it difficult to gratify your liberal thirst for science, without interfering with professional profits. Really, as Milman says, it would be well for the country if, instead of abolishing prebendal stalls, they were given to clerical and lay cultivators of literature and science, who had shown that they would devote energy and superior talents to those departments. When Babbage was taunted one day by a Conservative with 'What do you mean to be when the revolution comes?' he said, 'Lay Archbishop of Winchester'."

### Association of German Naturalists

THE annual gathering of the Association of German Naturalists—a society which was a forerunner of the British Association—was held at Jena on September 20–26, 1836. The meeting was attended by many civil and military officials, representatives from Great Britain, Russia, Belgium, Holland, Switzerland,

Greece and Mexico, and many of the greatest German men of science, including von Humboldt, von Buch, Ehrenberg, Weber, Hansen, Reichenbach, Fuchs and Döbereiner.

At the first general meeting, Dr. Kieser, after alluding to the philosophers and naturalists Jena had produced, gave a sketch of the history of the Association. Fifteen years previously, he said, it consisted of only thirteen persons, in 1835 it numbered 500 members and attracted friends from all parts of Europe and even from the other side of the Atlantic. In imitation of the Association, others had been established in England, France, the Netherlands and America. At the same meeting Mädler described the structure of the moon and exhibited his map of its surface.

There were three other general meetings, while papers were read to the seven sections: (1) Physico-Chemical Science; (2) Geology, Geography and Mineralogy; (3) Pharmacy; (4) Botany; (5) Anatomy, Physiology and Zoology; (6) Medical, Surgical and Obstetric Science; and (7) Technology and Agriculture. On September 24, the visitors and members were presented to the Grand Duke of Saxe Weimar, and after dining with him and other princes in the Orangery, repaired to the theatre, where Goethe's "Tasso" and Schiller's "Bell" were performed.

### Andrew Crosse and his Electrical Experiments

At the British Association meeting in Bristol in 1836, no communication raised more enthusiasm than the account given by Andrew Crosse (1784–1855) of his experiments on electric currents and their effects on minerals. Crosse was a man of means who lived at Broomfield on the Quantock Hills, Somerset, and at Bristol he gave a general invitation for any present at the meeting to visit him. The first to do so was Sir Richard Phillips (1767–1840), who described his visit in a letter to Mantell which was read at a conversazione of the Mantellian Museum at Brighton on September 20. The account was afterwards published in Sturgeon's *Annals*. Sir Richard spoke of the fine house and park and also of the music room in which were seven or eight tables filled with batteries. "They resembled battalions of soldiers in exact rank and file and seemed innumerable. Altogether there were 1,500 voltaic pairs at work in this great room, and in other rooms about 500 more. There were besides, other 500 ready for new experiments". But Crosse's "greatest electrical curiosity was his apparatus for measuring, collecting and operating with atmospheric electricity. He collects it by wires, the 16th of an inch diameter extended from poles to poles, or from trees to trees in his grounds and park".

### Walter Hancock's Steam Carriages

In the *Mechanics' Magazine* of September 24, 1836, is an account by Hancock of the work done by his steam carriages *Infant*, *Erin*, *Enterprise* and *Automaton* in London. He said that altogether these carriages had run about 4,200 miles, carried 12,761 passengers, made 525 journeys between the City and Islington, 143 between the City and Paddington and 44 between the City and Stratford. They had used some 55 chaldrons of coke. The same issue of the *Mechanics' Magazine* contained a description of the *Automaton*, the last of the four carriages to be built.

## Societies and Academies

### Paris

**Academy of Sciences, July 27** (*C.R.*, 203, 289–352).

AYMAR DE LA BAUME PLUVINEL: Obituary of Paul Stroobant.

J. GERONIMUS: Some orthogonal polynomials.

GEORGES GIRAUD: Complement to a result on equations with principal integrals.

KYRILLE POPOFF: The pendular movement of projectiles.

EMILE MERLIN: A particular case of trajectories of certain heterogeneous perfect fluids.

ASSÈNE DATZEFF: A transformation which keeps the form of canonical equations.

RAYMOND CHEVALLIER and MARCEL LAPORTE: The permanent magnetization of steel in the neighbourhood of a circuit traversed by a rapid aperiodic discharge.

LOUIS NÉEL: The theory of constant paramagnetism. The application to manganese.

G. FOEX and CH. FEHRENBACH: Variations of the magnetic moment of the cobalt ion in the anhydrous chloride and in the systems of mixed crystals $CoCl_2$-$CdCl_2$ and $CoCl_2$-$MnCl_2$.

MME. MARIE FREYMANN, RENÉ FREYMANN and PAUL RUMPF: The absorption spectra in the near infra-red of aniline derivatives.

ROGER SERVANT: A spectro-polarimeter for the Schumann region.

LÉON CAPDECOMME: The influences of elliptic light and of the orientation of the polarizer in comparisons of reflecting powers with the microscope.

PIERRE BRUN: The formation of metallic alcoholates.

HENRI MURAOUR and ALBERT MICHEL LÉVY: The spectrum of ionized calcium obtained by collisions with detonation waves.

ANDRÉ KLING and MAURICE CLARAZ: The rapid determination of oxygen in gaseous atmospheres.

JEAN BYÉ: Study of molybdic chlorhydrin and of the normal molybdate of glycol.

CHARLES BEDEL: The minimum temperature of oxidation of silicon. The lowest temperature at which the oxidation of silicon commences is relatively high: it is lowered by the presence of moisture.

MLLE. DENISE MONTAGNON: Contribution to the study of the double iodides of copper and ammonium.

CHARLES DUFRAISSE, LÉON VELLUZ and MME. LÉON VELLUZ: Dissociable organic oxides. Special study of 9-phenylanthracene and of some of its derivatives.

ROGER PERROT: Some nitrosochlorides of the benzene series.

MLLES. MARTHE MONTAGNE and YVONNE ISAMBERT: The action of ethylmagnesium bromide on butyric ethylanilide.

MARTIN BATTEGAY and PIERRE BOEHLER: α- and β-mononitroanthracene.

ANDRÉ MEYER and PAUL HEIMANN: The nitroso derivative of 4-hydroxycarbostyril.

GEORGES LÉVY: The nitration of β-ethylnaphthalene. The synthesis of 2-ethyl-8-naphthol.

GONZAGUE DUBAR and MLLE. DOROTHÉE LE MAITRE: New deposits of Spongiomorphides and of Algæ in the Lias and the Bajocian of Morocco.

CHARLES BOIS: Deep focus earthquakes.

ACHILLE URBAIN and R. CAHEN: The proportion

of derivatives of degradation of nitrogen in the serum of some ungulates.

RENÉ LEGROUX: The treatment of glanders in the Equideæ.

GEORGES BOURGUIGNON and MARCEL MONNIER: The variations of chronaxy under the influence of coloured light in spasmodic stiff neck.

BARUCH SAMUEL LEVIN and IVO LOMINSKI: Vaccination against bird plague with virus treated with X-rays.

### Melbourne

Royal Society of Victoria, July 9.

L. W. STACH: An Upper Oligocene bryozoan faunule. A small faunule at 66–67 feet in the Torquay bore is indicative of shallow water deposition. The range of *Cellaria depressa* is extended to Upper Oligocene, and a study of *Otionella cupola spiralis* Chapman suggests that *Cupuladria* Canu and Bassler is a synonym of *Heliodoma* Calvet. *Cucullipora tetrasticha* belongs to sub-family Hippoporininæ of Schizoporellidæ.

F. CHAPMAN and W. J. PARR: A suggested classification of the Foraminifera. The classification differs from Cushman's in the grouping of the arenaceous after the hyaline types. The whole order (Foraminifera) is arranged in the super-families, the Allogromoidea (chitinous), the Spirillinoidea (hyaline or perforate types), and the Ammodiscoidea (arenaceous, porcellanous and subarenaceous forms). The family groups of Cushman are re-sorted and reduced from 47 to 33. About 570 genera are admitted up to the year 1934, as against 144 genera in Chapman's "Foraminifera" of 1902.

G. W. LEEPER, ANN NICHOLLS and S. M. WADHAM: Soil and pasture studies in the Mount Gellibrand area, Western District of Victoria. A soil survey of 12,000 acres of pastoral country surrounding the volcanic cone of Mount Gellibrand. Nine soil formations are defined with laboratory analyses of each type, and mineralogical studies of the fine sand fractions. The present flora is described, and future development of the area discussed.

B. J. GRIEVE: The application of a staining and maceration method in tracing the distribution of bacteria in wood vessels of herbaceous plants.

### Moscow

Academy of Sciences (*C.R.*, 2, No. 4, 1936).

G. SIRVINT: Asymptotic series of Dirichlet.

L. VINOKUROV and E. LEVSHIN: Study of the extinction of luminescence of phosphorescent substances activated by organic activators.

G. G. LAEMMLEIN: Model of polymerized molecule of silicic acid in molten flow.

M. N. MICHAILOVA and M. B. NEUMANN: The cetene scale and the induction period preceding the spontaneous ignition of Diesel fuels in bombs.

S. J. KRAJEVOJ: The influence of ultra-short rays on the chromosomes of plants.

O. ISTOMINA and E. OSTROVSKIJ: The effect of ultra-sonic vibrations on plant development.

A. N. KLECHETOV: New species of *Colletotrichum* on the rubber-producing plant *Taraxacum kok-saghyz* Rodin.

A. SERGEJEV: The influence of human structures on the distribution of birds in steppes.

## Forthcoming Events

### Tuesday, September 22

ENGINEERS' STUDY GROUP ON ECONOMICS, at 6.30.—Annual General Meeting to be held at 23 Grosvenor Place, London, S.W.1.

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FARADAY SOCIETY, September 24–26.—General Discussion on "Structure and Molecular Forces in (*a*) Pure Liquids and (*b*) Solutions" to be held in the University of Edinburgh.

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## Official Publications Received

### Great Britain and Ireland

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 37: The Glaciation of the Bantry Bay District. By A. Farrington. Pp. 345–361. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 2*s*. [228

Department of Scientific and Industrial Research. Final Report of the Steel Structures Research Committee. Pp. xxvii+572+16 plates. (London: H.M. Stationery Office.) 12*s*. 6*d*. net. [228

Home Office. Report on Conferences between Employers, Operatives and Inspectors, concerning Fencing of Machinery and other Safety Precautions, First Aid and Temperature in Woollen and Worsted Factories. Pp. 19. (London: H.M. Stationery Office.) 4*d*. net. [258

Board of Trade. Survey of Industrial Development, 1935: Particulars of Factories opened, extended and closed in 1935, with some Figures for 1934. Pp. iv+36. (London: H.M. Stationery Office.) 9*d*. net. [258

London County Council. Lectures and Classes for Teachers: Handbook for the Session 1936–37. Pp. 86. (London: London County Council.) [258

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1682 (2030): Effect of Weight on Take-off and Landing. By E. Finn and S. P. Osborne. Pp. 13+5 plates. (London: H.M. Stationery Office.) 1*s*. net. [268

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1936–37. Pp. 408. (Manchester: College of Technology.) [268

Forestry Commission. Afforestation in the Lake District: Report by the Joint Informal Committee of the Forestry Commission and the Council for the Preservation of Rural England. Pp. 6+2 plates. (London: H.M. Stationery Office.) 3*d*. net. [278

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, July 30, 1936. Pp. 30. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [278

Forest Bibliography to December 31, 1933. Part 1. Pp. xviii+78. (Oxford: Department of Forestry, University.) [288

Papers from the Geological Department, Glasgow University. Vol. 18 (Quarto Papers of 1934–1936.) (Glasgow University Publications, 39.) Pp. iv+11 papers. (Glasgow: Jackson, Son and Co., Ltd.) [288

### Other Countries

Proceedings of the United States National Museum. Vol. 83, No. 2991: Pycnogonids from Puget Sound. By Harriet I. Exline. Pp. 413–422. Vol. 83, No. 2994: New Species of Polychaetous Annelids of the Family Nereidae from California. By Olga Hartman. Pp. 467–480. (Washington, D.C.: Government Printing Office.) [278

Smithsonian Institution: Bureau of American Ethnology. Bulletin 112: An Introduction to Pawnee Archaeology. By Waldo Rudolph Wedel. Pp. xi+122+22 plates. (Washington, D.C.: Government Printing Office.) 30 cents. [278

Smithsonian Miscellaneous Collections. Vol. 95, No. 13: A Comparative Study of the Labium of Coleopterous Larvae. By W. H. Anderson. (Publication 3393.) Pp. 29+8 plates. (Washington, D.C.: Smithsonian Institution.) [278

Cornell University: Agricultural Experiment Station. Bulletin 642: An Economic Study of Land Utilization in Broome County, New York. By T. E. LaMont. Pp. 51. Bulletin 644: Economic Studies of Dairy Farming in New York. 12: 150 Farms in the Tully-Homer Area, Crop Year 1931. By John R. Raeburn. Pp. 53. Bulletin 645: The Residual Effects of some Leguminous Crops. By T. L. Lyon. Pp. 17. Bulletin 649: Rural Youth: Activities, Interests and Problems. 1: Married Young Men and Women, 15 to 29 Years of Age. By W. A. Anderson. Pp. 63. Bulletin 650: Fertilizing Onions on Muck Soils. By J. E. Knott. Pp. 20. Bulletin 651: Quality of Lettuce as it affects the New York Lettuce Industry. By J. E. Knott. Pp. 17. Memoir 187: Effects of Light on Carotenoid Formation in Tomato Fruits. By Ora Smith. Pp. 26. Memoir 188: Genesis and Composition of Peat Deposits. By B. D. Wilson, A. J. Eames and E. V. Staker. Pp. 13. (Ithaca, N.Y.: Cornell University.) [278

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 10: Public Education in Hawaii. By Katherine M. Cook. Pp. 56. 10 cents. Bulletin, 1936, No. 18—IV: Youth . . . Vocational Guidance for those out of School. By Prof. Harry D. Kitson. Pp. vii+81. 10 cents. Pamphlet No. 69: Per Capita Costs in City Schools, 1934–35. By Lula Mae Comstock. Pp. 22. 5 cents. (Washington, D.C.: Government Printing Office.) [278

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# Human Tendencies

IN the annals of the British Association there will be found not one but many landmarks in the history of science. The Blackpool meeting of 1936, it is probable, will stand out as a whole, certainly in popular memory, as the one meeting above all others which from the inception of the Association up to that date has endeavoured to address itself on a united front to a diagnosis of the current ills of human society. The presidential address, no less remarkable for its controlled imagination than for its keen insight into and power of analysis of complex social phenomena, set the keynote of the meeting; and it was a striking testimony to the sense of responsibility to the community which is felt by the men of science of to-day that the lead given by the president of the Association was followed not alone by the sections dealing with the biological and humanistic sciences. Even a branch of study so academic, so apparently remote from the stress of current social problems as palæontology, afforded Prof. H. L. Hawkins in the presidential address to Section C (Geology), part of which appears in this issue of NATURE (p. 534), the material for pungent comment on current tendencies in human development.

It is possible, however, that on reflection there may appear no paradox in the fact that a science such as palæontology, of which the data are far removed from current events, should nevertheless provide a canon of criticism for tendencies of to-day. Although we may feel inclined to qualify Prof. Hawkins's dictum that our knowledge of the ancient Romans is at best equal to our knowledge of the trilobites, yet we may agree that as we can here view the beginnings, the prime, and the decay of long extinct species more clearly and more objectively than we can observe the rise and decline of the powers and empires of the past, so we may perhaps deduce from them more certainly the operation of biological laws which affect the evolutionary process in human affairs, no less than those which govern that process in the development of man himself.

Prof. Hawkins led his audience from stage to stage of evolution in organisms of the past to the emergence of man himself. It might seem a sorry commentary on his text for those who believe in the evolutionary process as a progression in perfectability to turn to the discussions and addresses in other sections, and to see what man has made of himself in the vast interval of time which has elapsed since that first emergence. There they would have found that man of to-day was being brought to the bar of judgment for handling the dangerous instruments of which scientific development has given him control with the mentality of a schoolboy, and as Lord Horder pointed out in the discussion on "The Strain of Modern Civilization", indicted as the subject of neuroses and auto-infection, because he has allowed himself to fall a victim to the organization which he himself has built up (see p. 529).

It is unfortunate that on the anthropocentric view imposed upon us by the condition of our being, the evidence of palæontology as an objective standard of progress should cease to be operative with the coming of man. When once man as such has evolved, palæontology can tell us little further of really fundamental and significant organic change. Unless mere size of brain be the criterion —in which event man may have surmounted the peak of his development with the passing of Neanderthal man, and modern man actually represent the entry on a phase of decline—on the coming of the modern man with his more highly

convoluted brain, that page of evolution is closed, in any event for the present, whatever the future may hold. From that point onward, throughout man's strenuous struggle to build up *civilization*, the evidence of change in man is indirect—and neither palæontology, archæology nor, except to a limited degree, history tells us what functional change may have accompanied his further development. Man as we see *ex post facto*, at the time of his emergence, is differentiated from his contemporaries of the animal world by the spirit, and by its achievement he should be judged. Less well equipped than any other animal approaching him in size with either protective covering or strength of tooth and claw, yet he is less at the mercy of his environment. Armed with the most powerful weapon of defence and destruction that Nature has forged, the human brain, he has conquered his environment so that not only has this otherwise defenceless creature made himself master of every quarter of the globe, irrespective of climatic and other environmental conditions, but also he is exterminating or subjugating all animal life, while exploiting all natural resources as well as conquering the air and drawing treasure from the depths of the sea. Hence man's progress in fact is commonly measured by his control of the material resources of the world.

It is scarcely necessary to stress the point to which this assessment of human progress in materialistic terms has brought us. A century of expansion and, on the whole, uninterrupted advance in every department of civilized life has now received a check. A prolonged period of economic depression and disturbed political conditions, international as well as in some instances internal, has dislocated what had come to be regarded as the normal flow of life, and has induced a wave of pessimism, which questions the values of what has hitherto been regarded as progress. Even the very fact whether man has progressed at all, at least since the early days of his emergence from barbarism, is brought into dispute. More grave, because more fundamental, is the judgment implied in the suggestion that 'progress', like Frankenstein's monster, has outrun the power of man to control it, and that therefore scientific investigation, which by its effect on production and therefore on labour is regarded as chiefly responsible, should be slowed down to enable consumption and employment to make good the lag rapidly forming a vicious circle from which extrication will be difficult or impossible. Although the British Association neither generally nor specifically in the meeting at Blackpool is legitimately to be regarded as the foster parent of pessimism, nor would be prepared to admit the ultimate sanity of any suggested check on scientific research or its application to practical affairs, yet the unanimity shown by the sciences in the recent debates, in diagnosing the underlying causes of the present situation as in some way or other involved in a lack of conscious direction, marks recognition of the gravity of the evil at the same time as it seems to point a way out.

The complaint that the strain of contemporary life is too great for human endurance is probably as old as the association of human beings in anything larger than a family group. Nor is it always the part of the *laudator temporis acti*. It certainly goes back so far as Horace when he longed for the quiet of his Sabine farm; it is familiar in the eighteenth century, as for example in the works of Smollett, and Sir Josiah Stamp quoted an apt example from the "Creevey Papers" in the reference to the "frightful" experience of travelling by rail at the rate of twenty-three miles an hour. These plaints, however, date from before the days of the machine, when individuality still had room for play. The more strenuous nineteenth century, with its doctrine of *laisser-faire*, encouraged the struggle of the individual, while imposing conditions upon labour and production against which it was the sense of the community that the worker should be protected. It is unnecessary to recapitulate the familiar story of the social and industrial development of the nineteenth and early twentieth century; but the principal trends which are germane to the present purpose are the growth of associations of both labour and employers, the application of scientific methods and results to all departments of production, as well as to the well-being of the worker, and the recognition by the community of its responsibility to see fair play as between employer and employed and the consumer and the producer, as well as generally to preserve so far as possible some balance between the rights of the individual and the claims of the group, whether trade organization or public authority.

The application of these principles to a large extent was opportunist, and so far as concerns the application of scientific methods and results to the problems of society and industry, was often more or less a consequence of pressure, frequently considerable, brought to bear on authority from

outside. Much has happened since then; and of all the lessons of the Great War, the most enduring and the most far-reaching have been the value of scientific research when applied to the problems and needs of practical life, and the impetus which can be imparted to concerted group effort under direction.

Of these two lessons the latter was already in principle familiar to the anthropologist. It is a form of the struggle for existence whereby man seeks to secure survival through combination in groups which ever increase in size and complexity. As a result of experience in the War, this principle has been transformed into a political dogma. It has produced on pseudo-scientific argument the totalitarian State, whether communist, fascist or quasi-constitutional under a virtual dictator.

The weakness of the totalitarian State is as obvious as its strength. It exalts the whole at the price of individuality, and in so far as it must in self-protection stamp the individuality of the many with the brand of the few, however wise and provident they may be, it will in the long run weaken the whole. For the group to survive must survive through the quality of its individual components. The problem of future research in the biological and humanistic sciences is to solve the equation of group interest and individual well-being. As Sir Josiah Stamp indicated in his presidential address to the British Association, the crisis in world economics and politics has forced it on our attention that there is a vast field in the constitution and character of man, his heredity, his training, his social and economic relations, more especially in relation to changing conditions, which await investigation. However intense and far-reaching may be the efforts of research directed to the improvement of material conditions, the result may be, who can say, perhaps more harm than good unless we understand more clearly than we do at present the whole nature of man and his reactions both as a unit and in the group. In the long run, the race will be to those who solve this problem.

# A Text-Book of Unapplied Biology*

Why Keep Them Alive?
By Paul de Kruif, in collaboration with Rhea de Kruif. Pp. vii+293. (London: Jonathan Cape, Ltd., 1936.) 10*s*. 6*d*. net.

DR. PAUL DE KRUIF is a writer better known, unfortunately, in his own country than in England. Beginning life as a bacteriologist, he soon abandoned academic science and research, and devoted his talents to the vulgarization (in the French sense) of scientific and medical discoveries—becoming, in his own words, "a sort of human loud-speaker, a barker", telling the world at large about some of the wonders of biology. In "Microbe Hunters" (1926), "Hunger Fighters" (1928), "Men against Death" (1932), he has already related, in colloquial American language, various outstanding 'triumphs' of bacteriology, nutritional physiology, and medicine. All these books are distinguished by the accuracy of their scientific and historical data, though these are often presented in a picturesquely overdrawn manner and from a national point of view not always appealing to a more stolid English audience.

As our author has already employed his scientific knowledge and literary gifts to good purpose, we turn to his latest work in confident expectation that he has again some arresting news to announce. And he has. He has discovered that the scientific and medical marvels which he formerly chronicled so dramatically and so hopefully are not being properly used for the benefit of humanity. Despite all our new knowledge—which he has already been at such pains to broadcast—about microbes, vitamins, and hormones, he finds that American citizens are still dying off like flies from starvation and avoidable afflictions. So he asks with righteous indignation why this is so. If we have not the sense to keep even our innocent little children alive and well in a world of knowledge and plenty—to stop them dying from starvation, and from preventable and curable diseases—why in Heaven's name do we let them live at all?

Both the contents and the temper of this disturbing book can be briefly indicated by the titles of its chapters (I almost said "the texts of its sermons"). (1) Why should they die? (2) Discovery that children are forgotten. (3) Discovery that it's dollars or children. (4) The power of science without money. (5) The people's death-fight. (6) Drouth is a blessing. (7) Who owns our science? (8) Observation of children of the shadows. (9) Should children eat? (10) Children can live! These headings give but a faint idea of the variegated and confusing pattern of the whole: yet the reader who conscientiously follows

the author to the last page—undeterred by his seeming inconsequence, verbal exuberance, and eccentric punctuation—will find that the game is worth the candle. He will find that he has incidentally acquired much exact information not only about infant mortality in the United States, the diagnosis and cure of consumption in Detroit, and the horrors of drought in Wisconsin and of the slums in Cincinnati, but also about such apparently irrelevant matters as the discovery of the tannic acid treatment of burns and the birth of the famous Dionne quintuplets in Canada.

From this wealth of detail it is not always easy to disentangle the main argument; but de Kruif appears to be trying to enunciate and solve, for a special case, a general problem of supreme scientific importance. How is it that Man, a supposedly intelligent animal, is still unable to use his painfully earned knowledge properly for the good of his own species? His scientific knowledge is already immense, and adequate for most of his specific needs; yet he has hitherto discovered no way to disseminate it for the benefit of all mankind, nor even to prevent its prostitution for human destruction. (This dilemma is, of course, familiar to readers of NATURE. So recently as July 18, an editorial article noted that "Nothing could be more unscientific than the contemporary armaments race, and the existence of widespread poverty and malnutrition in a period of unparalleled development of the technique of production, and the study of the science of nutrition".) But it makes de Kruif's blood boil when he sees people famishing in one of his United States while 'surplus' food is being destroyed in another: and he is driven almost to frenzy by the sight of children dying of starvation and preventable and curable diseases for lack of the money which his Government could find, if necessary, to kill another nation's children in warfare. He wants to know who is to blame for this sinful situation—and make him suffer for it.

Every man of science must sympathize with de Kruif in his indignation, and must share his passionate desire for reform. Nevertheless, it must be confessed that he himself appears to have found no solution of the fundamental problems which he attempts to formulate; and one may well even doubt whether any solutions are possible by his emotional method of approach. There are passages, it is true, in which he appears to favour some form of communism as a remedy for our present economic, social, and scientific disorders; but he is too great an individualist to pursue that line of argument very far. Moreover, when the question of guilt arises, he has an uncomfortable feeling (haven't we all?) that even he himself may not be entirely blameless—for isn't it *his* duty to do something about it? So he takes refuge in the thought that, after all, he is "only a reporter": it is not his job to put things right. When everything else fails, he seeks eternal truth by fixing his eyes on the horizon of Lake Michigan—just as the monks of Mount Athos formerly did (if we may believe Gibbon) by contemplating their navels.

Such consolations are not for everyone, however, and the question of responsibility for the non-application and misapplication of science has got to be faced more scientifically. In a sense, of course, the blame rests upon all mankind—including men of science themselves: but the excuse that "I am only a reporter" (or "only a man of science", which is equally valid) is surely but an echo of the voice of Cain—"Am I my brother's keeper?" Is it likely to be more acceptable? Yet no man engaged upon research in pure science—a whole-time job—can attend to the proper application of his discoveries (if any) at the same time. Though de Kruif now says in the heat of the moment that "science for science's sake" is "balderdash", he knows full well that science must be made before it can be applied, and that no man can serve two masters.

While reading this just indictment, I have been repeatedly reminded of a more famous work published two centuries ago—"A Modest Proposal for Preventing the Children of Poor People in Ireland from being a Burden to their Parents or Country, and for making them beneficial to the Publick" (Dublin, 1729). In this little tract Jonathan Swift, as everyone knows, answered de Kruif's question. He was equally appalled by the wastage of child-life in his own day, and in this shocking satire endeavoured to stir public opinion by the outrageous advocation of cannibalism. The Dean of St. Patrick's is not noted for the terseness of his style: but in this tract he appears almost a Tacitus in comparison with de Kruif, whose prolixity and varied repetitions and seeming contradictions often obscure rather than stress the points in his argument. His feelings—obviously very noble feelings, inspired by well-authenticated facts—too often overpower his thoughts. Indeed, the very title of his book—commendably short in comparison with the Dean's—typifies this defect. His question is merely rhetorical, and appears to be scientifically unanswerable: at all events, de Kruif is not really concerned with its answer. At the beginning (p. 25), it is true, he postulates that "Children must live"; but clearly this is no satisfactory logical reply to the question why they should be kept alive.

But it is much easier to criticize and compare this challenging diatribe than to answer the numberless questions which it raises. Some of

these—though not that asked in the title—are really urgent: they concern all mankind at the present moment. Consequently, I hope that de Kruif's latest utterance will reach the widest possible audience, and will not be dismissed as merely local propaganda: for it is far more than this, and deserves serious consideration by everyone who is not content with modern misuses and non-uses of science and scientific method.

I have referred throughout to Paul de Kruif as "the author" because this book is written in the first person singular, though admittedly the offspring of marital collaboration. (All Paul's earlier books, moreover, were dedicated "To Rhea".) If I now look somewhat askance at their newborn child—still a raw product, whose future development no man can predict—it is surely with no ill-will. Indeed, I sincerely hope that this child may escape the fates of those pitiful other babes about whom its parents write so feelingly, and that it will live to lead a long and useful life in the service of all humanity. Clifford Dobell.

# Atomic Spectra

(1) Introduction to Atomic Spectra
By Prof. H. E. White. (International Series in Physics.) Pp. xii + 457. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 30s. net.

(2) The Theory of Atomic Spectra
By Prof. E. U. Condon and Dr. G. H. Shortley. Pp. xiv + 442. (Cambridge: At the University Press, 1935.) 42s. net.

THE experimental study of atomic spectra has a long and distinguished history. Even the descriptive analysis of spectra in terms of series and term values—the systematic botany of spectra—has a history of some sixty years. It is only, however, since Bohr's explanation of the hydrogen spectrum in 1913, and still more since his further work in 1921 explaining the structure of the periodic table of the elements, that any fundamental theory of atomic spectra has been available, or any rapid advance in observation or systematics has been made. Indeed no such advance was previously feasible, even on the experimental side, for the experimenter did not know what to look for. The field of atomic spectra provides in fact a perfect example of the way in which experiment and theory can react fruitfully on each other, yielding advances in our understanding of the field at a rate which could scarcely have been anticipated even by the most optimistic. Since 1921 the advance has been so rapid that it is fair to say, as Condon and Shortley do in their introduction, that the interpretation of atomic spectra is now finished in broad outline. All known features of atomic spectra have been at least semi-quantitatively explained in terms of the nuclear atom, strictly according to the laws of quantum mechanics. The period of fruitful research in atomic spectra is not thereby closed, for there remain many important details to be elucidated further, and the proper relativistic theory of the many-electron system to formulate. None the less an epoch is ended.

The growth of the theory of atomic spectra in its early stages was identical with the growth of the quantum theory. The empirically determined requirements of the hydrogen spectrum, including the Stark and Zeeman effects for that spectrum, with assistance from the spectra of the alkalis and alkaline earths, led by themselves to the formulation of Bohr's correspondence principle. From this principle to quantum mechanics the climb, severe as it proved until led by Heisenberg, is short and inevitable. The study of the tremendous field of more complex spectra played only a comparatively minor role in this development, although the first successful systematizations of these spectra preceded it. Once quantum mechanics had been formulated, it was soon found that the whole body of spectra fell together into one consistent scheme, the unforced immediate interpretation of which remains one of the chief glories of quantum mechanics—an achievement sufficient by itself to convince the most sceptical. It is this complete interpretation which is presented in the two books here under review, in White's from the point of view of the experimenter, in Condon and Shortley's from that of the mathematical physicist.

(1) After an introduction covering the history of investigations on atomic spectra, and the developments made by the old quantum theory, and giving some account of Schrödinger's equation and the Dirac electron, White's book gives a general account of atomic spectra in terms of the vector model. This account is in every way admirable from the point of view of the experimenter, or of the intelligent student who may prefer or be forced to approach the subject with little knowledge of mathematics. All the results of quantum mechanics are stated in the form of rules, for which the vector model provides a reasonable unity of appearance, and are elaborately applied to actual spectra, but the readers of the book are not primarily concerned with the

derivation of these rules from any general theory.

Theirs not to reason why
Theirs but the rules to ply,

and this is certainly a good, possibly the best, attitude in which to begin the study of atomic spectra.

The various rules such as the branching rule, the intensity rules, Lande's $g$-rules and $\Gamma$-rules, the permanence rule for the $g$- and $\Gamma$-sums, can all be presented quite simply and fairly systematically in terms of the vector model, adapted to quantum mechanics by taking the square of any angular momentum vector $L$ to be $L(L+1)$, so long as one is prepared not to worry overmuch about the reason provided by quantum mechanics for the procedure specified by the rule. This is the attitude adopted by White, and it results in a most successful book, which can be heartily recommended to the readers for whom it was written. Some of them may even feel that the presentation could just as well have been even less related to the underlying theory, and that some part of the description of the old quantum theory could perhaps have been omitted.

One of the best features of White's book is the obvious glee with which the author writes of features of the more complex spectra, such as "the great calcium triad". Enthusiasm is infectious, and the reader is conducted willingly through fields which might well have proved arid. His willingness is rendered all the greater by the profusion and excellence of the diagrams and plates. Some of the most beautiful of these are the electron cloud photographs which demonstrate the relationship of the Schrödinger's wave functions to the orbits of Bohr's older theory.

(2) Condon and Shortley have written a book which is as different from White's as two books on atomic spectra could well be. They are concerned almost exclusively with the strict derivation from quantum mechanics of the rules of the vector model and other general features of atomic spectra. The space devoted to comparisons between theory and actual observations has been necessarily reduced to a minimum. Such comparisons can be found elsewhere, notably in White's book.

Many methods of presentation are open to an author setting out to expound the mathematical theory of atomic spectra. The main classes of presentation will be determined by whether one admits or excludes the explicit use of certain branches of pure mathematics, notably group theory and matrix algebra. Condon and Shortley admit matrices and exclude groups. They explain that in their opinion, in which the reviewer concurs, the explicit use of group theory would make too great demands on the mathematical equipment of too large a proportion of those mathematical physicists who might be expected to read such a book on the theory of atomic spectra. Not long ago, the same might have been said about matrices, and even to-day the matrix algebra which dominates large portions of the book may prove a difficulty to some readers, though probably only to the older ones. Even such readers, however, will probably put the book down convinced that matrix algebra has come into the subject to stay, and that to attempt to write the mathematical theory of spectra without this compact and powerful language would be retrograde if not impossible.

It will now perhaps be useful to survey in rather more detail the contents of this book. The introductory matter consists of a résumé of Dirac's exposition of quantum mechanics and his theory of observables, of the matrix algebra of angular momenta and of the classical radiation theory. With this background the argument proceeds to a complete discussion of one-electron spectra, which is then extended to many-electron spectra in great detail. An admirable feature of this part of the discussion (both in Condon and Shortley's and White's books) is that both Russell-Saunders and $j$-$j$ coupling are considered separately on an equal footing. Both are almost equally important limiting cases, and in Condon and Shortley's book there is an instructive chapter tracing theoretically the transition from one to the other through the various stages of intermediate coupling. Having thus completed the theoretical background used in the systematic description of all ordinary spectra, the authors bring X-ray spectra into the optical scheme in a most satisfactory way by a discussion of the properties of almost closed configurations, of which both X-ray terms and many optical terms in the rare gas spectra are equally examples. The book continues with an excellent account of Hartree's method of the self-consistent field, and of the accurate calculations by the Rayleigh-Ritz method of the normal state of helium-like structures, and another of the interaction between different atomic configurations leading to perturbed series and many-electron jumps. The closing chapters describe the Zeeman, Stark and nuclear effects on atomic lines.

No one but an habitual worker in the field of atomic spectra could hope usefully to criticize in detail an exposition such as the present, and the reviewer can make no such claim. Its power and thoroughness leave the general impression of a work of the first rank, which successfully unifies the existing state of our knowledge, and will prove for many years a starting point for further researches and an inspiration to those who may undertake them.

R. H. F.

# Compression Ignition Engines

(1) **High Speed Diesel Engines:**
with Special Reference to Automobile and Aircraft Types; an Elementary Textbook for Engineers, Students and Operators. By Arthur W. Judge. Second edition, revised and enlarged. Pp. xi + 347 + 41 plates. 15*s*. net.

(2) **Maintenance of High Speed Diesel Engines:**
a Practical Handbook for Diesel Engine Fleet Owners, Maintenance Engineers, Operators, Drivers and Mechanics. By Arthur W. Judge. Pp. vi + 192 + 32 plates. 10*s*. 6*d*. net.
(London: Chapman and Hall, Ltd., 1935–36.)

(1) THAT a second edition of this book should be called for within two years is a tribute alike to the widespread interest in the subject and to the manner in which Mr. Judge has dealt with it. No doubt most of its readers are interested principally in the application of the compression ignition engine to road vehicles and in a lesser degree to the more difficult field of air transport.

The rate of growth of road usage has been remarkable, as the London streets alone bear witness; but the prospect of there being produced an attractive engine for aircraft operation is still one of 'Jam to-morrow' rather than of anything more immediate. Reliability for road usage has been achieved; but the pursuit of this elusive quality for engines with the lighter scantlings necessary for aircraft has proved arduous. So far, the undoubted merit of freedom from the worse forms of fire risk has been balanced, and rather more than balanced, by the disadvantages of greater weight and less dependability. Indeed, reasonable freedom from forced landings is an essential to any air service which depends on the patronage of the public; whilst for military use the petrol engine gains greatly in any comparison by its lighter weight.

One of the virtues of the compression ignition engine is always held to be the freedom it gives from all the complications attendant on the electric ignition system but, as Mr. Judge's pages bear witness, the alternative complications of fuel pump and fuel piping show that there is little to be gained by this exchange.

In the large-scale use for motor transport, there has been shown to be a large saving in fuel costs, and, in Mr. Judge's view, even the present fuel tax will not cause this to disappear. The general utility of the engine in this field, where high crank-shaft speeds are essential, has been won in no small measure by attention to the production of turbulence in the air close to the fuel inlets. The bearing, on this factor, of ingenuity in cylinder head design is fully brought out by the author.

The book is very practical, and it will find many engineers who will value its possession as a really up-to-date guide on a subject which such a vast number of them have to deal with in their daily work. It is true that it is a compilation of work done by others rather than an exposition by a master, but the latter it does not profess to be.

(2) Mr. Judge's second volume relates solely to care and maintenance, and does not call for special remark. It appears to be a thorough compendium of useful experience and practical hints. It will no doubt find its circle of readers.

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**Down to Earth:**
an Introduction to Geology. By Carey Croneis and William C. Krumbein. Pp. xviii + 501 + 64 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1936.) 17*s*. 6*d*. net.

IT is unusual, in Great Britain at all events, to find a book of elementary science enlivened with facetious illustrations. Such, however, is the case in "Down to Earth", a volume of nearly five hundred pages by Croneis and Krumbein, published by the University of Chicago Press. There is a large number of figures of which one may be cited as a sample of many. It is entitled "Earth has not yet answered the question of her origin" and Earth is represented as a girl in a straw hat, short skirt and apron scratching her head, and is being pointed at by three stars in top hats and walking sticks. In addition to the many figures there are sixty-three plates which at first sight look as if they had been taken from some weekly illustrated magazine. Yet the book is a very good one. The plates, each one made up of several good photographs or on occasions diagrams, convey a great deal of sound information on various aspects of geology, palæontology and their applications to modern life. Not all the text figures are humorous; many are the more usual form of diagrammatic illustration, portraits or reproductions of historical medieval text figures. The text is good and conveys a great deal of information. A school boy or girl might perhaps be attracted by the lighter aspects of the volume to absorb the more solid parts, which in fact form the larger part of the work.

**Biologie der Tiere Deutschlands**

Herausgegeben von Prof. Dr. Paul Schulze. Lief. 37. Teil 26: Orthopteroidea II, Phasmodea, Saltatoria. Von Max Beier. Pp. 233–415. 16.50 gold marks. Lief. 38. Teil 9: Acanthocephala, Kratzer, von Friedrich Bock; Teil 31: Hemiptera III, von Herman Weber. Pp. 9+209–355. 16.50 gold marks. (Berlin: Gebrüder Borntraeger, 1934–1935.)

THE first portion contains two chapters, one dealing with the Phasmids (stick insects and their allies) and the second the Saltatoria (locusts, crickets, etc.). While other forms are mentioned in the first chapter, it is largely built round *Carausius morosus*. It includes a good account of the anatomy and histology, particularly of the sense organs, but all dealt with in correlation with function. In addition, the reproductive activities and the reactions of the animal are adequately discussed. The second chapter, which deals with the subject matter in the same manner, actually treats of a number of different species and so has a wider basis.

The second portion deals with two separate groups, the Acanthocephala and certain Hemiptera. The structure and life-histories, including the relationship between parasite and host, are very clearly set forth in some of the better known Acanthocephalids. In the introduction, the classification employed is given, and a few pages farther on is a useful list of fifty-eight worms with their final hosts and, where known, the first and second intermediate hosts also. From this it is clear that in many instances the individual species of parasites show a very wide choice of hosts.

The section on the Hemiptera is subdivided into the Aphids and the Coccids. After a satisfactory review of the morphology of the group illustrated by reference to a series of types, there follows a very useful discussion of the life-cycle of these interesting insects. Much of the information is set forth in the form of diagrams, which facilitate comparisons between the different life-histories. While the part relating to the Coccids is somewhat shorter than that relating to the Aphids, it nevertheless covers the ground adequately.

A good feature of all these contributions is the close correlation between the morphological and functional aspects of the problems. The animals are treated as living units so that the series well merits its title of 'Biology'. All the illustrations are well chosen and well reproduced; the information is up to date and the several chapters are furnished with good bibliographies.

**Geometrical Optics**

By Dr. H. T. Flint. Pp. ix+266. (London: Methuen and Co., Ltd., 1936.) 7*s.* 6*d.*

DR. FLINT has accomplished a task which leaves teachers of optics very much in his debt. He has produced an elementary treatise which begins at the very beginning of the subject, expounds a rule of signs lucidly and fully, and, after discussing in sufficient detail the topics associated with an intermediate course in optics, goes on to treat of thick lenses, combinations of lenses, aberrations of various kinds, apertures, photometry and optical instruments. Under the last heading are given brief but adequate discussions of the microscope and telescope, the eye and its defects, eyepieces, resolving powers, and various photographic objectives. Those of us who were trained in the optics of a generation ago will recognize the debt that the author owes (and acknowledges) to Drude, whose treatment of the one-to-one correspondence between points in the object- and the image-space is, in general, followed.

That Dr. Flint is the author is sufficient guarantee of the clarity and elegance of the treatment of the subject, and one of the chief virtues of the book is that it leaves the student with nothing to unlearn, whatever may be the direction of his subsequent studies in optics.

Here and there are examples of treatment concerning which divergencies of opinion are permissible. Thus, in discussing focal lines the author very naturally bases his treatment on the properties of lines of curvature—it is the method of approach natural to the mathematician. So far as the average student is concerned, the reviewer finds that method of approach most useful which is based on the properties of the caustic; this, however, is a very minor matter.

If a suggestion may be made, it is that, in a future edition, a few *laboratory* exercises might with advantage be added, and that, in the exposition of the properties of the cardinal points, the Bravais points should not be forgotten.

The book may be unreservedly recommended to students in the final or junior honours grade in the universities.

**Physical Chemistry for Colleges:**

a Course of Instruction based upon the Fundamental Laws of Chemistry. By Prof. E. B. Millard. (International Chemical Series.) Fourth edition. Pp. ix+524. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 21*s.*

WRITTEN, for the main part, in terms of the classical thermodynamic and statistical theory, the fourth edition of this book, nevertheless, gives adequately the facts of recent discoveries. Chapters involving numerical work are pleasingly free from ambiguity, so that the student should find little difficulty in working through the excellent assortment of problems appended to these chapters, although these exercises would probably be more helpful if the answers were provided.

In his treatment of modern physico-chemical theory, Prof. Millard is sound rather than provocative. Thus, while the existence of activated molecules is deduced as a result of the breakdown of the kinetic theory of reaction, their position in the electro-chemical theory of valency is only briefly mentioned. In the same way, heterogeneous reactions, treated largely as an application of the Phase Rule, might well have been correlated with the modern theories of adsorption and catalytic activation. Minor drawbacks of the book include the lack of formal definition, for example, of heat of reaction, order of reaction, etc., and the ambiguous use of the terms atomic weight, gram-molecular weight, etc.

# The Strain of Modern Civilization*

By the Right Hon. Lord Horder, K.C.V.O.

FROM the early days of the primitive curse, life has always imposed its strain upon mankind. It is the penalty we pay for living at all. Philosophers have always assured us that we cannot have life without it. Indeed, they have assured us that some degree of strain is good for us. There is, however, implicit in the title of this discussion the suggestion that the stress of modern life has new elements, and is excessive. In the street, the trained eye detects in the physiognomy of the people the early stages of that concern which, in the consulting room and in the hospital ward, shows itself so frequently as the more established picture of 'anxiety neurosis', unloading itself upon the digestion, the circulation and other bodily functions, which are really more sinned against than sinning. 'Functional' diseases, as against 'organic', have increased, whether in the field of the nervous system proper, the heart and blood vessels or the internal secreting glands. I must not stay to expand, or even to justify, these statements; few, if any, medical men will contest them. In case after case, a tactfully conducted pursuit after fundamental causes removes the screen of headache, insomnia, indigestion and fatigue, and the anxiety factor is revealed.

In the sphere of microbic infections, as I have pointed out elsewhere, we have new diseases for old. Preventive medicine has freed us from many of the severer epidemics, as also from many fulminant sporadic infectious diseases. Tuberculosis has come largely under control. But in place of such plagues as these, there is an increase in the incidence of those more subtle germ diseases which we call "sub-infections", in which the virulence of the microbe is low, whilst the susceptibility of the host is high. In many of these diseases the germ comes from within and not from without: "a man's foes" are "they of his own household". In short, we are becoming the victims of our own saprophytes. And the only reason we can assign for all this is a 'give' on the part of our own resistance to auto-infection—a 'give' which seems to follow a lowering of the control exercised in health by the nervous system. Such control is, in a strict scientific sense, only a postulate; it lacks proof; but is it likely that, with nerve control of so many other functions proved, we shall find that the important function of immunity is an exception?

So much for some of the effects of nerve strain. What of the causes? It is almost platitudinous to speak of the anxiety connected with the competition of living, and now with the equally grave and increasing sense of international insecurity; of the pace at which we live; of the precariousness of life itself in the streets, so that we seem in these days to live by accident rather than to die by it; of the monotony and drabness inherent in many workers' long hours of physical and mental effort; of the lack of air and of exercise and of sleep; of the exciting nature of our amusements, whether the immediate demand for them be normal relaxation or a dope; of noise—needless, stupid, provocative, ill-mannered, selfish noise. . . . Platitudinous, and yet, on reflection, the major premise holds good in respect of all these factors.

There is a notion afoot that, in the last analysis, science is largely responsible for the extent and persistence of much of the strain of modern life. I want to say, at once, that I regard this unloading upon science as mere pusillanimity. I hold the view that it is not too *much* science, but too *little* science, that has helped to get us into this trouble. Or rather should I say, not enough interest *in* science and not enough direction given *to* science. What interest does the average individual really take in science and to what extent is he prepared to encourage it? The answer is, almost nil. Which is odd when we reflect that he recognizes quite fully—as how can he fail to do?—that at the present time both politics and economics—and some would add even religion—regarded as systems existing for human betterment, seem to have failed him, and science alone is not bankrupt. Science has, indeed, loaded man with benefits, but he has shown an indifference to them, or a carelessness and a prodigality in his use of them, which is quite pathetic.

A Spanish writer says in this connexion that, speaking for himself, . . . "the disproportion between the profit which the average man draws from science and the gratitude which he returns—or, rather, does not return to it: this is terrifying. I can only succeed," he continues, "in explaining to myself this absence of adequate recognition by recalling that in Central Africa the negroes also ride in motor cars and dose themselves with aspirin".

Not only ungrateful in thought and attitude, but ungrateful in mishandling the benefits accruing from scientific endeavour. Blame science? We need not drive a car so fast that it kills, or make

* From the introduction to a discussion in Section I (Physiology) of the British Association at Blackpool on September 15.

a loud-speaker so loud that it deafens. Science was made for man, not man for science, and the one thing that matters is control. Are we going to drive the machine, or are we going to let it drive us? Mr. H. G. Wells, in one of his inimitable word pictures, portrays civilization as a high-powered motor-car gathering momentum on a precipitous hill, a quaking, gibbering monkey at the wheel, impotent to check its increasing speed. Not complimentary, but terribly suggestive.

Who cares about the direction along which science produces her gifts to mankind? We have an astronomer royal, but we have no biologist royal, still less a psychologist royal. Is this a survival from the days when we thought the stars controlled our destinies? But if "the fault . . . is not in our stars but in ourselves, that we are underlings", as I believe it is, should we not 'do something' about this? Hygiene of the body—the idea seems, at long last, to have been grasped; 'mental hygiene', after a long and painful labour, is, I think, being born. What of spiritual hygiene, the hygiene of temperament? I believe that the spirit of man is fundamentally as amenable to scientific investigation, if not to control, as is his body and his mind.

Amongst the remedies for the ill effects of the strain of modern life, I place first more science, and especially science directed towards the study and development of the mind and the spirit of man. Then it behoves us to guard and support all those amenities which are actually in existence or which are struggling for recognition: leisure for the artisan, the factory hand, the labourer, the shopman and shop woman, the housewife—and for "all who grunt and sweat under a weary life"; slum clearance; playing fields; national parks; the National Trust; physical training; adult classes; pictures; poetry; music; museums; libraries; architecture; quiet for the brain worker and others. Whether our outlook be mainly that of the eugenist or that of the environmentalist, we must not "cease from mental fight" until we have, by these and other means, "built Jerusalem in England's green and pleasant land". I risk platitudes once more but again the major premise holds.

The critic may, however, be saying: "that's all very well; you are only dealing with the individual; it is the mass for whom you must prescribe, the mass that is arising here, and there, and that will determine the trend of civilization in the near future, and even determine whether it continues to exist or not". But, personally, I see little hope for the people of Great Britain through mass movements. Fascist or Communist, when individual freedom has been sacrificed, I see no chance of achieving that control in the spiritual sphere through which alone, I believe, salvation can come to the human race. What matters the colour of men's shirts if these are soon to be their shrouds? Or what matters their numbers? The falling birth-rate in Great Britain is causing some people concern. As a disciple of Francis Galton I am much more interested in the quality than in the quantity of our people. When the clash comes, if come it must, between these two hordes of the new barbarians—civilized barbarians if you like—it may well be that the salvaging of the world, or its doom, may depend upon whether Northern and Western Europe, and America, have been able to preserve an individualized society, or, like the two opposed masses in the dictator countries, have yielded to the tremendous pressure of what may prove to be a bastard civilization and have caught the infection of despair. If our own individualities refuse to be tub-thumped, or intimidated, into a pulp, all may yet be well and the clash may be averted. Meanwhile, "'a plague on both' their blouses!" We had troubles enough of our own with which we were busily, and not altogether unsuccessfully, coping: the loud-speaker next door, the roar of the sports-model car up the street (night-silence for hooters notwithstanding); and now comes another fire-eating speech from a dictator on tour, or an account of one of these orgies of human sacrifice by which an executive hopes to maintain its precarious control. No wonder our nerves are kept on edge.

Much of what I have just been saying may sound like a statement of my own views on international affairs rather than the contribution of a doctor towards the treatment of a disease. But I wanted to emphasize my opinion that remedies that depend upon parading or dragooning patients in the mass are spurious remedies, and are, therefore, unlikely to be finally effective in freeing the world from the strain that it is suffering.

Recently we have been witnessing the invasion of medicine by mass methods, by direct action, by force. The results have been very disappointing. Too often we have had to admit that many of these therapeutic efforts did little more than demonstrate the triumph of technique over reason. We had to start all over again, working out the particular case, and following the indications carefully. That is, we did this if the direct action method still left us a patient to treat. We remembered—what we never should have forgotten—that it is only by this segregation and study of the individual, and attention to his particular needs, that we have any good chance of restoring him to health. It is for this reason that I have dealt with mass movements as efforts towards restoring that sense of security which is essential to national and to international well-being. The analogy from medicine is all against treating the crowd, and all in favour of treating the individual.

It may, however, be advanced that what may not succeed in Great Britain may succeed in Russia or in Germany. Of this it behoves us to hold an open mind. But it also behoves us to be vigilant lest we sell the birthright of our national characteristic, which is individual freedom and poise, for one or other of the vaunted panaceas that are offered us from outside. I say all this at the risk of being charged with egregiousness—a common charge against Britons.

There is another characteristic in a British patient: to treat him successfully he must be treated through his intelligence and through his will, not through his emotions. He responds badly to the '*ça passe*' method.

Nor shall we, if we be wise, listen seriously to the various panaceas offered to us from within. There are several of these. In respect of the worrying menace of war, and the perpetual anxiety it creates, there is the doctor who says: "sign a post-card *against* war, say you won't *have* war". Which sounds reminiscent of that old story, attributed to President Coolidge, who laconically summed up the preacher's sermon on sin by the statement, "he was against it". Or as who should say, "I don't hold with cancer". But who does? This sort of thing doesn't help anybody. Whereas the sentiment implicit in the soldier-poet's question, "Who lives if England dies?" *does* help, nor is the man or woman who is braced by such sentiment necessarily a jingo or a blatant patriot. Ideals are essential for us all, and are invaluable tonics, but the British patient does better on a practical and an attainable ideal than on one which is, in this present world, too visionary. "The test of truth in matters of practice is to be found in the facts of life, for it is in them that the supreme authority resides."

Then, just as we get the hypochondriac in matters of the body and of the mind, so there is in some quarters, or so it seems to me, a tendency to spiritual hypochondriasis. There are folk who, to use Carlyle's significant simile, spend much of their time looking at their own navels, and even comparing them with those of their friends: much too subjective an occupation to be healthy. We break up the hypochondriac situation by exhorting the patient to be more objective in his outlook and to leave his body alone. His body troubles him less when once he effects this orientation. If for 'body' we read 'soul', the same result may be safely predicted from the same treatment. Following a medical thought, I regard these panaceas as being of the nature of quack remedies, because I do not think that they really deal with the facts inherent in the situation. We are asked if Soviet Russia can change human nature. Frankly, I doubt if it can, because I think the change must come from within and not from without. And if we are given time, and given freedom from paralysing fear—fear, the arch-enemy—we can reduce these strains of modern life by effecting a better adjustment in ourselves to the rapidly changing conditions of our times, reducing the pace at which we live, and achieving control. Given time to meet, and to know each other better, we can pool our various national traits. In the last analysis, we are mostly good fellows with similar needs and probably with similar destinies.

When Browning makes Paracelsus say, "Make no more giants, God, but elevate the race at once", he seemed to subscribe to the element of charlatanry with which tradition debits that romantic figure. As I have already said, I do not think the cure will come that way. I believe that only "man can elect the universal man". But I have faith that the human heart *is* "made of penetrable stuff". I do *not* think that "damned custom" has "braz'd it so, That it is proof and bulwark against sense", though at this moment a morbid Hamlet, were he looking on, would doubtless take that view.

I think, rather, that there are still enough people, "whose blood and judgment are so well commingled that they are not a pipe for Fortune's finger To sound what stop she please"—enough of these sturdy folk to check the disease and to re-establish health. The treatment is the treatment of the individual by the individual. Any physician who can inspire "Gentleness, Virtue, Wisdom and Endurance" will help to hasten and establish the cure. Any physician who cannot prescribe these remedies obstructs the cure, and should stand aside.

Is it permissible, in an assembly of scientists, to end on a transcendental note? If so, I would remind myself that the spirit of man, though often needing comfort and reassurance, and perhaps never more than now, is still the dominant factor in all the experiences that it meets, be those experiences in the bodily, mental and spiritual health of the individual or of the race.

"The Lords of life,
I saw them pass,
In their own guise,
Portly and grim—
Surface and dream,
Some to see, some to be guessed,
They marched from East to West:
Little man, least of all
Walked about with puzzled look.
Him by the hand dear Nature took,
Dearest Nature, strong and kind,
Whispered, 'Darling, never mind!
To-morrow they will wear another face,
The founder thou; these are thy race!'"

# Evolution of the Solar System

SIR JAMES JEANS opened a discussion on the evolution of the solar system on September 10 at the Blackpool meeting of the British Association. Prof. A. Holmes described the geological evidence concerning the age of the system; Prof. E. A. Milne discussed its dynamical aspects from the point of view of his recent work on the foundations of dynamics and gravitation; in the absence of Mr. R. A. Lyttleton, his binary star hypothesis of the origin of the system was described by Prof. W. H. McCrea; Prof. V. Bjerknes spoke on some hydrodynamical aspects; Dr. Harold Jeffreys stated some problems raised by the chemical composition of the planets, and summed up the discussion. Some of the points raised are summarized here.

No theory of the origin of the solar system has yet gained general acceptance. Indeed, until quite recently, none existed which satisfied all the following simple general tests: it should explain (i) the production of satellite systems as well as the planetary system; (ii) the regularities in the sequence of the planetary masses, of the ratios of the masses to those of the largest corresponding satellites, and of the numbers of corresponding satellites, when the planets are arranged in order of distance from the sun; (iii) the birth of the system at an epoch when the physical constitution of the sun was not greatly different from what it is at present; (iv) the large amount of angular momentum possessed by the outer planets.

Arranging the chief theories in order of the number of bodies involved in the birth of the system, we have first Laplace's nebular hypothesis. The origin is sought in the cooling, and consequent shrinkage and speeding up of the rotation, of a single nebular mass of gas extending initially beyond the orbit of the outermost planet. The planets are supposed to be formed from rings of matter thrown off in the process of shrinkage; but there is a failure to explain how such rings could condense into planetary form, or how they could possess the observed amount of angular momentum even were the condensation achieved.

Laplace's theory is found, in fact, to involve an insufficient number of adjustable parameters. So various subsequent theories (Buffon, Proctor, Bickerton, Chamberlain and Moulton, Jeans, Jeffreys) have appealed to the intervention of a second body. Some twenty years ago, Jeans proposed his tidal theory, which at the time was the most successful in this category. A second star was supposed to have described a hyperbolic orbit about the sun and it was shown that, if the approach had been sufficiently close, the tides raised in each body by the gravitational pull of the other would have become unstable and grown into a great filament of gas in the space between the two. The gravitational instability of this gas would cause it to condense into planetary masses, some of which would be retained in the gravitational field of each of the two stars. This theory is particularly successful in explaining the regularities noted under (ii), but, as Jeffreys and H. N. Russell have pointed out, and as its author admits, it again encounters difficulties with regard to the peculiar distribution of angular momentum. Some of the difficulties Jeffreys has tried to remove by imagining a still closer encounter of the two stars than Jeans had postulated.

Russell was the first tentatively to suggest that three bodies had been concerned in the production of the solar system, by supposing that the sun was originally a double star, and that the planets were formed by an intruding star encountering, not the sun itself, but its original companion. The actual production of planets by the encounter would be supposed to proceed as on Jeans's theory, but it would now clearly be possible to account for their large angular momentum about the sun, or, what comes to the same thing, their large distance from the sun. Russell himself saw difficulties in explaining how the companion and intruder could both escape from the sun after the encounter, and still leave the planets entangled in the sun's field. R. A. Lyttleton, however, independently put forward the same hypothesis, and at the same time showed that these difficulties are not inherent in it. He has demonstrated that, for ranges of real values of the initial velocities of the bodies involved, it is possible for the encounter of the companion and the intruder to communicate velocities to them which carry them both "to infinity" in different directions, while parts of the tidal filament formed between them, and endowed with velocities intermediate between those of the escaping stars, would have velocities insufficient to get away from the sun's gravitational field. Further, this may happen for initial velocities of the intruder relative to the sun of the same order of magnitude as the observed relative velocities of stars in the same neighbourhood of the heavens.

The theory can be developed to account for the similar sense of revolution of the planets round the sun, for their rotations, and for the existence of satellites. The latter are supposed to be formed by tidal encounters of pairs of planets when, in their revolution round the sun, they both arrive

back simultaneously in the same neighbourhood as where they were originally formed. That they should do so before they have had time to condense appears improbable, and this is one of the objections that have been raised against the theory. Nevertheless, so far as Lyttleton's theory has been worked out—it is still in its early stages—it does seem capable of accounting for all the *dynamical* features of the solar system.

Geology cannot say anything about the origin of the earth, but from radioactivity data it can set a well-established lower bound to its age. The generally accepted theory of the formation of rocks has indicated where the oldest exposed examples are to be found, and the lead-ratio method has shown these to be about 2,000 million years old, but their constitution shows them to have been made, by weathering and fusion, out of still older rocks. However, combining this information with that got by Paneth concerning the age of meteorites as given by their helium content, we are led to the figure of about 2,700 million years as the age of the solar system. Geological evidence based on seasonal effects preserved in the structure of the varved clays, and on the recurrence of glaciations, shows further that there have been no large changes in the dynamical and thermodynamical relations between the earth and the sun for something like 2,000 million years.

A study of the chemical composition of the planets leads to many grave difficulties, as Jeffreys has emphasized. For example, in the case of the outer planets, the order of increasing mass is the order of decreasing density, which seemingly admits the explanation that when the masses were gaseous the stronger gravitational fields were better able to prevent the lighter elements from diffusing away into space. But now for the inner planets, Mercury, Venus, Earth, Mars, and also the moon, the order of increasing mass is the order of *increasing* density, which is inconsistent with any such simple explanation. Again, the earth consists of a rocky shell of mean density about 3·3 and a central liquid (probably iron) core of mean density about 12. The mean density of the whole moon, on the other hand, is about 3·3, so that it evidently does not possess a heavy core. This suggests that, if the moon was formed by the breaking up of a planetary mass, then it took place after the heavy elements in the latter had had time to settle down towards the centre, indicating that the formation of the satellite took a considerable time. However, most theories of the formation of satellites require them to have been formed very early in the history of the planets. Also it is difficult to explain how the earth retained any light elements unless its crust solidified very quickly, and it is then difficult to see how the moon could have been formed after solidification. In fact, in the present state of the theory, any explanation of one feature of the chemical composition of the solar system appears to be contradicted by some other feature.

The difficulty about the angular momentum of the system has been mentioned. Lyttleton's theory is the most successful attempt hitherto made to resolve it on the basis of ordinary mechanics. There may still be other ways; for example, E. W. Brown has pointed out that the theory of the perturbation of one planet by another might lead to an exchange of angular momentum between them, if it were carried to a higher degree of approximation than is usually done. But a much more fundamental resolution of the difficulty is now put forward by E. A. Milne on the basis of his recent work on the foundations of dynamics. In this work he starts from observers' immediate consciousness of *time*, and their description of motion based thereon, and is able to derive the forms of the laws of dynamics and gravitation from purely kinematical considerations. He postulates the equivalence of observers in regard to their observation of each other and of the rest of the universe, but he does not need to appeal to experience for any empirical 'laws of motion' or of 'gravitation'. His results are derived first in terms of *kinematical time* $t$. He then finds that they pass over into the local empirical Newtonian forms on transforming to *dynamical time* $\tau$, where $\tau = t_0 \log (t/t_0) + t_0$, and $t_0$ is the present value of $t$ obtained from the expansion of the universe. The value of $t_0$ is about $2 \times 10^9$ years, which is also about the age of the solar system given by radioactivity data.

So this would place the origin of the solar system at about the singular epoch $t = 0$ occurring in the kinematical theory. If the correspondence were exact, then, since $\tau \rightarrow -\infty$ when $t \rightarrow 0$, the age of the system, reckoned by dynamical events such as the revolution of a planet round the sun, would be infinite. In other words, in dynamical time the solar system never had a beginning. This suggests a reconciliation between the 'short' and 'long' time scales, which have presented inconsistencies in connexion with many cosmological problems.

Another consequence of the theory is that angular momentum is not a time invariant, but the angular momentum of any local system grows at a rate proportional to itself. Thus small initial differences of angular momentum tend to be magnified as time goes on. This would remove difficulties connected with the rotation, not only of the solar system, but also of spiral nebulæ, in which the amount and distribution of angular momentum has long been a puzzle. It should be added, however, that this theory also has yet been given only in a preliminary form. W. H. McC.

# Palæontology and Humanity*

By Prof. H. L. Hawkins

PALÆONTOLOGY gives no direct evidence as to the origin of groups, of whatever taxonomic grade; its scope is limited to records of the later stages in the careers of groups already in existence. This is not to deny that the presumptive evidence for the birth of new types is overwhelmingly strong; but actual tangible proof of their parentage and generation is lacking. A palæontologist is more of an undertaker than a midwife.

Again, fossil evidence cannot give convincing demonstration of the origin of structures in organisms; its scope is restricted to observation of the fate of those structures after they have appeared. There must always be a theoretical quality in attempted explanations of the development of new characters; there are facts recording what happens to them in course of time.

The only language which adequately expresses the nature of morphogeny is that used in description of individual life. Structures, once originated, pass through stages of development, modification and amplification that are closely analogous to the phases of personal history, both physical and psychological. There is a continuous duplicity, in that intrinsic characters are involved with external requirements; environment is educative but not creative. There is a limit to the response to environment possible for any structure; if that limit is exceeded, disaster results. Every character of an organism, like every complete creature, is more responsive to environmental influence in its early history than later. Directions of development induced or encouraged by environment become gradually ingrained; just as practices oft repeated become ineradicable habits. In contrast with modern municipal tendencies, trolley-buses are transmuted to trams.

The several characters of an organism are at once independent and inseparable; each can follow its own line of development, but unless a balance is kept within the whole series, collapse is certain. Just as different groups of organisms show very different evolutionary speeds, so the various structures in a single organism become modified at varying rates. The attainment of mature perfection from a stage of immaturity can never be more than a transient phase on the way to a fresh disproportion comparable with senility.

Structures, and with them the organisms to which they belong, grow old, exhausted or hypertrophied by their own intrinsic expenditure of evolutional 'effort' amid an ever-fluctuating embarrassment of circumstance.

We come to the conclusion that the oracular recommendation to know ourselves is a guide to the secret of evolution. Physically and (in the human case) psychologically, we live our lives as compromises between hereditary tendencies and environmental requirements. As we grow older our accumulated load of compromise becomes an obsession, reducing our capacity for further efforts of the kind; and our environment never tires in its changefulness.

If we consider these principles in the light of the struggle for existence, we find that those types which can attain the most perfect harmony with their environment will flourish proportionately. But their success brings Nemesis in its train; for speedy evolution towards dominance implies continuous speed; the perfection point is passed by the same momentum that reached it. Undoubtedly the victor in the struggle for existence wins the prize; but the prize is death.

When we attempt to apply to human affairs the principles of evolution as shown in palæontology, many difficulties appear. Not the least of these is the impossibility of a dispassionate outlook; we are proverbially unable to see ourselves as others see us. Another serious difficulty arises from the shortness of the time during which our species has existed, and the paucity of trustworthy evidence that it has left of its history.

At the outset we must admit that the basis of our analysis of mankind will be on a different plane from that which we employ in the case of other organisms. Morphological and physiological characters change so slowly that we cannot expect to find much alteration during our brief career; and in any event there is practically no evidence of that sort available. But if the conclusions already reached as to the universality of the law of evolution are accepted, it matters not a whit which particular attribute of an organism we select for study. Behaviour is but an expression of the reaction between the qualities of an organism and its environment, and civilization is a kind of behaviour. This argument is not so specious as it may appear, for the evidence available to check its validity is ample.

* From the presidential address to Section C (Geology) of the British Association, delivered at Blackpool on September 14.

Before following that line further, it will be well to attempt an estimate of the qualities of the human species as they appear to a palæontologist. This is a dangerous task; for I am bound to omit, for the time being, reference to many human attributes. I must appeal for patience; I am fully aware of the incompleteness of the analysis I am about to make; later, in a desperate attempt to arrive at a happy ending, I propose to give consideration to those qualities in man that truly differentiate him from other animals.

If it be asked how a student of 'lower' orders of organisms (and those defunct) can presume to include the human race in his purview, a plea of justification can be made on two grounds. Mr. Tony Weller gave it as his opinion that "the man as can form a ackerate judgment of a animal can form a ackerate judgment of anything". This generalization, like all others, may be debatable; but the course of human history, in so far as it is known, shows features typical of the course of evolution revealed by palæontology.

The outstanding physical peculiarity of the human species is its upright posture, a feature to which many of its bodily structures are far from completely adapted. In spite of its relatively large size, the human body cannot be claimed as exceptionally capable. A man stripped of the instruments of his devising, left to compete on equal terms with the other occupants of his restricted environment, would stand no better chance than they. It is true that he could perform most of the actions expected of land animals, but none of them superlatively well. Were he compelled to rely on his bodily characters alone, there would be little more reason to single him out for special consideration than there would be the capacity to do so.

The mental powers of man are those that place him in a category apart from other creatures. By the exercise of his wits he can find compensation for structural shortcomings, and challenge, defeat and control all other living things. With the help of the machines that he invents, he can project himself successfully beyond the normal range of terrestrial animals, transporting his body and his habits over the sea and through the air. He can, within fairly wide limits, overcome the influence of environment.

With no intent to belittle the mechanical achievements that have brought man to his commanding position, we must admit that few of them can be claimed as original. They are copies, often improved editions, of devices that already existed in the animal creation, coupled with applications of natural forces that are as old as the world. Man's capacity for generalization has enabled him to foresee the effects of his inventions, and so to reduce the time that would otherwise have been spent on the costly method of trial and error. He can transmit his experiences to his own and following generations, so preventing (for those who listen) a wasteful repetition of mistakes. The speed with which he has beaten all other creatures at their several games is commensurate with the degree of his success. Paradoxically he has become supremely generalized by the exercise of a highly specialized faculty.

It is difficult to find any type of animal behaviour in which man cannot excel. Whether in the strictly mechanical processes, such as locomotion or building, or in the more subtle qualities of affection and aspiration, he stands revealed as an exaggerated animal. There are no activities, constructive or destructive, and no habits, pleasing or loathsome, in which he cannot outdo the most accomplished animal.

This analysis leads to a somewhat equivocal result. On one hand, the high cerebral specialization that makes possible all these developments, and the extraordinary rate at which success has been attained, both point to the conclusion that this is a species destined to a spectacular rise and an equally spectacular fall, more complete and rapid than the world has yet seen. On the other hand, the wide range of directions into which the specialization extends, and the measure of control over environment that it entails, seem to suggest a peculiar kind of plasticity that might pass for generalization, with the consequent hope of a long time-range. In this uncertainty we must look for such facts as are available, facts of history which are at least comparable with the record of palæontology. But first we must estimate the relative value of the evidence afforded by human history.

Fossils and historical documents alike give but a fraction of an account of the matters of which they treat. In both cases the story of the early stages of racial progress is imperfect and often mythological; the episodes of decline and fall are more fully documented. But, in contrast to palæontological evidence, human accounts are always suspect. Written records of events represent an impression made on one, or at best a few, minds; they may—indeed they must—be tainted with prejudice and ignorance even when they are not deliberately falsified. The impious rebellion of one writer is the glorious revolution of another. Whatever may be the criticisms levelled at the transcribers of natural history, no doubts can be cast on the essential truth of the record they try to interpret. As an academic proposition, it may be debated as to whether a misread fact is preferable to a misread falsehood; but there is at least a chance of finding the truth in the former case.

Again, the bulk of human history is the record of the performance of a few actors on a specially selected stage; palæontology, with all its imperfections, gives a picture of events in fairer proportion. The parts of human history usually recorded represent the activities of man the intensified animal, rather than of man the half-fledged angel. The behaviour of the animal is the more rational, and so easier to remember and describe. But from very early times another factor has entered into human affairs—a factor illogical and wayward, but every bit as real to a man as his animal qualities. This factor, which we may call 'altruistic', makes human actions often unintelligible in the present, and still more so in the past. For example, it is easier to find a rational explanation of the presence and characters of a *Micraster* in the Chalk than to form a plausible hypothesis as to the meaning of the Stonehenge that men erected over it. Man can safely claim to be unique, for he is the only irrational creature in the world. A palæontologist may be excused for looking askance at a record of creatures like that written by one of themselves.

Nevertheless, man leaves other traces of his activities besides written screeds, and many of these records are as revealing, and as unintentional, as the shell of a mollusc. By piecing together archæological materials, and fitting documentary accounts into the plan of this mosaic, a conception of human history can be gained that comes within measurable distance of scientific evidence. We have more established knowledge of the Belemnites than of the Incas, but perhaps we know almost as much about the Romans as about the Trilobites.

It would be wearisome to reiterate the various features wherein the history of human affairs corresponds with the course of evolution in other groups. Whether we consider individual lives, dynasties or empires, the same depressing story applies. Some races, once dominant in their particular sphere, have disappeared entirely; others, fallen from high estate, linger in inglorious decay. But all those brave civilizations and empires of which we have records seem to have shown a succession of similar histories. They have risen from obscurity through possession of successful attributes, and have reached the peak of their power only to pass it. Some have rotted away quietly, others have fallen before the onset of less rotten stocks or perhaps of extra-human disaster. Many of the early empires were on so small a scale that their rise and fall had merely local effect; others have been more comprehensive, and their dissolution has spread havoc over wide areas of the world.

Until comparatively recently, there has been a persistent proportion of 'backward' types, unaffected by the civilizing influence of the progressive powers. These have remained as a quiet background to the transient pyrotechnics of the others. They remained to provide a new upstart when the current one had crashed. To-day there are few races of this kind left; almost all mankind has encountered civilization and either perished or been transmuted. The fatal complexity of civilization grips the whole species, crushing it into unity.

The specific causes of the collapse of once dominant races are doubtless varied; but there is general agreement that one universal factor in disintegration is complexity, an aspect of over-specialization. The units of an empire, be they individuals or factions, tend to work together in harmony during the period of upward struggle; but when a position of dominance is won, they continue to struggle. When there are no new worlds to conquer, they begin to fight among themselves. Selfish aims replace patriotic ones, and the community becomes discordant.

The correspondence between this state of affairs and the morphogenetic trends in other races of animals is so close that it needs no elaboration. Those who deny that human institutions are subject to the laws of organic evolution know either no history or no palæontology. Many proverbs give epigrammatic statements of the principles of evolution in imaginative terms.

> "Ill fares the land, to hastening ills a prey,
> Where wealth accumulates and men decay."

The history of extinct empires, which should be studied as a cautionary tale, is commonly regarded as providing an example to be followed. Human nature has the curious trait of gambling against the laws of cause and effect. We always hope that the fate that befel our predecessors will pass us by. Babylon, Egypt, Rome, Spain all traversed the same track; and to-day we follow in their footsteps hoping to reach some different goal.

If this were all, man's outlook would indeed be dark. According to temperament we might as well sit with folded hands in a darkened room awaiting the inevitable end, or meet the crash with ribaldry and riot. Our peculiar quality of superior mentality seems but a suicidal acquisition, hastening and intensifying the imminent doom. But the human mind is more than a fabricator of evanescent institutions. It can transcend utilitarianism (wherein it but exaggerates animal qualities) and can form idealistic conceptions.

Ideas of chivalry, honour and self-sacrifice have no place in the struggle for existence; but they are inherent in all but hypersophisticated minds. Among ordinary folk, conceptions such as these are stronger incentives to action than animal

impulses, as even the most rascally demagogue knows. Learning, philosophy and art are realities to which men will devote their lives, creating rather than copying, with no ulterior or mercenary aim. The arts and virtues bring a new and incalculable feature into the story of evolution. Some, at least, of their achievements outlive kingdoms and empires, seeming immortal.

Men are, for the most part, enthusiastic admirers of virtue, even to the extent of devising laws to ensure its maintenance. Very many of them are actual exponents of virtue in their personal relations; but in public affairs and in the mass they are often content to behave as animals rather than as men. "Manners makyth man" is perhaps the most concise specific diagnosis ever published. But there is only one law of evolution, common to individuals and races alike. If mankind as a whole neglects its "manners", it abandons any claim it may have to qualitative difference from other animals. There is no doubt of man's ability to become the most successful type of animal that has ever existed; but the reward of success in that direction is death.

The love of truth, greatest of all virtues, is especially an attribute of men of science. In this we are idealists, for the truth is unattainable, however worth the seeking.. We know that all the progress that our species has made, in material as well as in mental affairs, is the result of the search for truth. We find ourselves strangers in a world riddled with more or less blatant deceit; but we still follow our ideal, confident that all other paths are blind. We recognize in the conception of truth something eternal, not subject to the laws of change and decay.

We know that idealism is the goal and incentive in all actions that can truly be described as human. To the idealist, environment is something to be overcome or adapted into service; the story of human progress is one of triumph over circumstances. The self-styled 'realist', who advocates acceptance of, and submission to, his temporary environment, is less than a man; he follows in the tradition of the beasts that perish.

To idealists palæontology has no message, save to welcome them as something new in Nature. To realists, who seek material success in the struggle for existence, palæontology, with millions of years of history as its authority, declares emphatically, "You have been warned."

# Obituary

## Mr. C. Fitzhugh Talman

With the death on July 24, at the age of sixty-one years, of Mr. C. F. Talman, the U.S. Weather Bureau loses one of its best known members.

Talman was born at Detroit on August 31, 1874, and joined the Weather Bureau in October 1896. From 1898 until 1899 he was in charge of the meteorological stations maintained by the United States in South America and the West Indies; afterwards he was attached to the Weather Bureau Library, where he found his true vocation. He received the official title of librarian in 1908, and though he became junior professor in 1912, professor in 1914 and meteorologist in 1922, he remained in charge of the library throughout. He was intensely interested in bibliographical work, and his knowledge of meteorological literature became almost unique. In addition to the annotated lists of new books and papers which he compiled regularly for the *Monthly Weather Review*, he delved deeply into the history of meteorological terminology, publishing his results in semi-popular articles on "The Language of Meteorology", "The Meteorological Isograms" and "The Vocabulary of Weather". The last, which was reprinted in the *Quarterly Journal of the Royal Meteorological Society* for 1925, ends with the words: "I have been gathering wind-names from the literature of all countries, ancient and modern, for many years, and endeavouring to elucidate them from both the etymological and scientific standpoints. . . . It is a fascinating occupation and I only regret that I have, apparently, the whole field to myself".

Another outcome of Talman's hobby was his selection as meteorological adviser for the "Standard Dictionary" in 1910–11. He had a pleasant literary style, which also found expression in two popular books "Meteorology, the Science of the Atmosphere" (reprinted in 1925 as "Our Weather") and "The Realm of the Air" (1931) and in numerous newspaper articles, but his interest was the collector's rather than the author's, and he published only a small part of his material. It is greatly to be hoped that means will be found for editing and publishing his notes.

We regret to announce the following deaths:

Dr. J. B. E. A. Charcot, the well-known French explorer of the Antarctic, on September 16, aged sixty-nine years.

Mr. J. W. Gordon, K.C., honorary secretary of the Optical Convention in 1912, and author of "Generalized Linear Perspective, with Special Reference to Photographic Land Surveying", on September 21, aged eighty-two years.

Mr. Ernest Payne, a pioneer in X-ray research work, on September 20, aged seventy-six years.

# News and Views

### Problems of Present-day Astronomy

IN connexion with the recent meetings of the British Association, Sir James Jeans delivered a public lecture at Southport on Friday, September 11, on "Some Problems of Present-day Astronomy". He confined his attention to theoretical astronomy, and dealt almost exclusively with large-scale problems concerned with the character of the universe. After a brief survey of the general structure of the stellar universe, Sir James described the various kinds of nebulæ, directing attention in passing to Kuiper's recent discovery, in a planetary nebula, of "what may well prove to be the smallest of all known stars" —a body with a radius about half that of the earth, a surface temperature of about 2,800° C., and an average density about 36 million times that of water. The theory that the extra-galactic nebulæ were formed by condensation out of an originally unstable continuous mass of gas filling all space next claimed attention, and Sir James remarked that mathematical investigation shows that condensations in such a medium would be "on something like the scale of the observed nebulæ, and would be at something like the same distance apart".

SIR JAMES then turned to problems concerning the character of space. Relativity taught us that the total volume of space was finite—a statement apparently at variance with a later suggestion that the curvature of space might be negative and with Einstein and de Sitter's demonstration that it might be zero—but the latest observations disclosed no thinning out of distant nebulæ to indicate that we have yet explored an appreciable fraction of its extent. The systematic separation of the nebulæ from one another was described from two points of view—first as a movement of bodies in a structureless space and secondly as a system of drifting 'straws' revealing the motion of 'currents' in a space whose character the motions served to indicate. For knowledge of the original and present size of space we are dependent on theoretical arguments, and Sir James gave in this connexion a brief description of the theory of Sir Arthur Eddington relating the expansion of the universe with the mass of the electron. According to this theory, the radius of the universe was originally about four times the distance of the farthest nebulæ now known, and has since expanded about tenfold. This consideration would seem to call for further elucidation of the earlier remark that the theoretical separation of the condensations in the primeval universe is about the same as that of the observed nebulæ. The lecture was liberally illustrated by lantern slides.

### Preservation of English Scenery

SEVERAL important aspects of the preservation of English scenery were mentioned by Dr. Vaughan Cornish in an address to Section E of the British Association at Blackpool on September 14. In the first place, insisting that a scene from which Nature has been expelled is no fit dwelling place for man, he urged the brightening of towns by rebuilding schemes which give higher buildings, and that in a smaller area accommodate the same number of people, and so leave land free for gardens and boulevards. Dr. Cornish went on to insist that the mere preservation of monuments of antiquity is not enough. It is necessary to preserve a contemporary background as in the case of Stonehenge, the Roman Wall, and the ancient earthworks of the Downs. In these respects, however, the danger to natural amenities is less great than in the threat to the cliff-lands of England and Wales. A considerable extent of our five hundred miles of cliff-land is in danger from bungalows, hotels and other buildings. Before it is too late, the last of these cliffs should be acquired and preserved as national parks. This would necessitate the acquisition of a strip little more than 100 yards in width. Several stretches of Cornish cliff-land are specially suited for national reservations, but it will have to be accomplished soon or the builder will have damaged them beyond redemption. The concluding part of Dr. Cornish's address was devoted to a plea for the recognition as national parks of the New Forest, the Forest of Dean, the Pennine Moors and the Lake District. Cliff-lands, woodlands and mountains would then be represented, these being the three types of English scenery of special importance.

### *Angiolo Filippi (1836-1905)*

OCTOBER 23 marked the centenary of the birth of a leading Italian medical jurist, Angiolo Filippi, the son of a distinguished medical practitioner of Florence. He studied medicine at Pisa, and directly after qualifying gained some useful knowledge for his subsequent career first as a prison doctor and afterwards in the campaign with Garibaldi, where he acquired considerable experience of gunshot wounds. In 1865 he distinguished himself by his devotion to the sufferers from the cho era epidemic at Ancona, San Severo and Apricene. In 1875 he became assistant to Prof. Bellini, who occupied the chair of legal medicine at Florence, and succeeded him in 1884. His "Manual of Forensic Medicine", of which the first edition appeared in 1889 and the fifth in 1919, was the first of its kind to be published by an Italian expert, and proved an indispensable work of reference to the medical and legal profession in Italy. His other works were "A Manual of Thanatology and Traumatology" (1877) and "Medico-legal Exegesis of the Method of Giving Evidence" (1882). He founded a laboratory for medico-legal research in Florence, and his methods of investigation were followed in other Italian schools of medical jurisprudence. He died on December 30, 1905.

**British Commonwealth Scientific Conference**

A CONFERENCE was opened by the Right Hon. Walter Elliot, M.P., Minister for Agriculture, and attended by representatives of the Governments of all portions of the British Commonwealth, on the morning of Monday, September 21, in London. Its chief function is to examine the work and future of a number of scientific organizations established on a co-operative basis to perform a common service in various branches of agricultural scientific research. As a result of the Imperial Agricultural Research Conference of 1927, the several Governments of the Empire agreed to establish bureaux or centres of information in eight branches of agricultural science, financed by contributions from all parts and controlled by a council representative of all parts of the Empire. To these, the supervision of two older institutes was added in 1933 on the recommendation of the Imperial Committee on Imperial Economic Consultation and Co-operation. In addition, the Conference is considering the future of certain research schemes to which several parts of the Empire now contribute, and also further methods of the interchange of information and closer collaboration in scientific work.

AFTER the opening meeting on Monday, the Conference inspected the bureaux and centres of information which deal with mycology, soil science, animal health, animal nutrition and genetics, plant genetics (non-herbage and herbage), fruit production, and agricultural parasitology. The Conference re-assembles in London on October 2. The Executive Council of the Imperial Agricultural Bureaux, of which Sir Charles Howell Thomas is the chairman, is responsible to all Governments of the Empire equally for the administration of these common services, and in conformity with the resolution of the Imperial Conference of 1926 is constituted on a basis of equality of representation. It was decided by the Governments in 1933 that where such common organizations are formed, their activities should be subject to detailed examination at periodical conferences. This Conference serves that purpose.

**Species in Foraminifera**

THE veteran palæontologist, Frederick Chapman, who has retired from the National Museum at Melbourne and is now consulting palæontologist to the Commonwealth of Australia, has contributed to the *Melbourne Age* (under the initials F.C. and under date February 8, 1936) a column headed "The Species Nightmare: an Absorbing Scientific Problem". One of the oldest living authorities on the Foraminifera, trained under H. B. Brady, W. Kitchen Parker and W. Rupert Jones, whose assistant he was until his appointment to Melbourne, he deals with this difficult question, quoting Mr. Heron-Allen's communications to NATURE of July 14, 1934 and November 16, 1935. Frederick Chapman deals with it in connexion with other branches of palæontology, and deplores what Heron-Allen termed "the commercialisation of Protozoology", and his article, which is worth the serious attention of all systematists, but is too long to quote adequately, should receive careful attention. Mr. Heron-Allen is consulted by many of the rising school of petroleum geologists at the Natural History Museum, and, regard being had to the deplorable fact that their lists of species are now regarded as a 'trade secret' not to be divulged for the information of rival petroleum merchants, his advice to these young men is to adhere to the genera established by the great nineteenth century school, both in England and on the Continent of Europe, and to distinguish their species, for their own reference and guidance, only by numbers, or by letters of the alphabet, ignoring the thousands of names given to minor varieties by the American School. By this means they can save themselves an immense amount of labour and brain-fag, and their tabulated results are quite as useful as they would be if they were overloaded by a vast nomenclature which it is impossible —and unnecessary—for the human brain to retain.

**Invention and the Modern State**

THE externals of modern civilization are the products of invention, and a scientific analysis of invention, what it is, what causes it and whither it is leading us, is long overdue in England. In such an analysis the statistical method must predominate and the easy generalization will have no place. It may require research of a difficult and unusual kind, but unless we know, for example, accurately and in detail, the origins, the training and the methods of successful present-day inventors, we do not know the sources of the real progress-making inventions of to-day, and while we are ignorant of that vital fact the recital of a short list of so-called working-man inventors of the eighteenth century is not merely valueless but also misleading. Mr. C. W. Marshall has just concluded in the *Inventor* a series of articles on "The Science of Invention". In them he attempts to interest and guide inventors of various degrees of proficiency, but, although the trend of recent patent applications can be learned from them, the articles are entirely devoid of statistics. As a consequence of this and of the very diverse standards of the inventors to whom the articles are addressed, their total effect is confusion. At one place advice is being given as to the "psychological factor"; for example, "a camera idea, may be submitted to manufacturers in the autumn so as to be ready for the spring sales". Shortly after this we learn—or do we?—that the "price of inventions used to vary from £1,000 for 'gadgets' to half a million for inventions such as refrigeration and automatic photo machines". Again, "There is a ready market for inventions which cheapen production of exclusive products. By introducing mass-production machines and an entirely re-designed, simplified product the early Fords were able to tap the potentially great motor-buying public".

No one, it would appear, would care to challenge Mr. Marshall's contention that "so keen is the competition, so deep the technical advance now, that the

principle of hit or miss, except perhaps in the gadget class of invention, is not applicable, and the complete inventor is a development of the scientific researcher". But to such a man, the suggestion that he would find it worth while studying Max Planck, Einstein and Eddington would come rather late, while that suggestion, even if accepted, would have no utility to the 'gadget' producer. The high hopes raised by the receipt of a treatise with the title "The Science of Invention" remain unfulfilled by Mr. Marshall's series. An authoritative examination of the position of invention in the modern State is still needed. In such an examination the commercial aspect may well prove to be insignificant, although research by one man or one set of workers may have to be restricted to the material inventions, leaving such things as modern systems of government, the most striking development of man's inventive faculty, to the historian or the alienist. From a calm investigation of the uses of material advances it may be found that they follow social changes and are called forth by them: but research is necessary to discover the vital facts of modern invention and, in Great Britain at any rate, there is little evidence that such research is being carried out. Is it fantastic to believe that if it is ever adequately made, we shall have general consent to the idea of complete control by the State of the inventive faculties of its members?

### Viability of Plant Structures

THE question of the length of the period of viability in seeds and other plant organisms is constantly cropping up, and, although a great deal has been written about it, there is still much to be discovered with regard to the actual length of time seeds and spores can remain viable. Reference was made to this problem in NATURE of May 2, 1931, p. 675, and an article on the subject was published in the *Kew Bulletin* of 1933, p. 257. In that article, all the cases of longevity that have been definitely authenticated were brought together. Possibly the oldest case is that of *Nelumbo* (the Japanese lotus) recorded by Ohga in the *Botanical Magazine* of Tokyo, 1923. Seeds of *Nelumbo nucifera* were found in a peat bed buried under 2 ft. of loess in Southern Manchuria. The seeds all germinated and it is estimated that they were at least 120 years old and may have been as much as 400 years. It is well known, of course, that poppy seeds and charlock can retain their viability for very long periods, but for how long one cannot say definitely. According to an announcement in *The Times* of August 19, M. P. N. Kaptereff has succeeded in reviving plant organisms which have lain in the earth for thousands of years. It appears from this account that it is only spores which have shown signs of life, and it seems quite possible that spores of some of the lowly algæ could have survived in a frozen condition for a very long time. From the account it appears that blue-green algæ may be some of the plants which have developed —possibly some of the unicellular green algæ also. As to the grass-like plants which are mentioned, they might well have retained their general appearance in a frozen condition for a very long time, as the ice would preserve the form perfectly well. One would not expect them to have any life in them and this does not appear to have been the case.

### Native View of Baganda Institutions

AN account by an African of his own institutions must normally, though not invariably, have an exceptional value for the ethnographer. Being as a rule a spontaneous production, it avoids the great danger of the usual method of inquiry, in which there is the risk of biasing the sources of information. Sir Apolo Kagwa, the *Katikiro* of Uganda, who produced in 1918 an account of Baganda history and institutions in his native language, was exceptionally well qualified for this undertaking. A man of considerable intellectual power, he had been associated with the royal household from his early youth, and when in 1897 the young Daudi Chwa, an infant, one year and six months old, was appointed king on the abdication and flight to German East Africa of his father, Mwanga, Apolo was made regent and prime minister. He thus had a personal and intimate knowledge of the critical times which led up to the intervention of the British forces in Uganda and the institution of a protectorate. His authority on State affairs and ritual is beyond question. One of the most valuable records he has preserved is that of the officers and queens of each ruler from the beginning of the line with the semi-legendary founder Kintu. The Rev. J. Roscoe, when collecting information for his book "The Baganda", derived a great deal of his material from the *Katikiro*; and, in fact, Sir Apolo's book, which is an invaluable, and indeed a necessary, supplement to Roscoe, was written to expand and correct what he considered to be open to criticism in the work of the latter. The fact that Sir Apolo wrote in Luganda has proved a drawback; but this has now been remedied in a translation by Ernest B. Kalibala, edited by May Mandelbaum (Edel) (*Columbia University Contributions to Anthropology*, 22, 199. 4 dollars). For the convenience of students the mere repetitions of Roscoe's information are omitted, but references to "The Baganda" are given here as well as where Roscoe is supplemented or corrected.

### Safety in Mines Research

As in past years, the Fourteenth Annual Report of the Safety in Mines Research Board includes a report of the Health Advisory Committee, which forms in fact Part 4 of the Report, the previous parts being Part 1, General; Part 2, Instruction; and Part 3, Progress of Safety Researches. The Report, of course, begins with an expression of regret on the death of Dr. J. S. Haldane, who "had been a member of the Board since 1923"; there is not a miner who will not re-echo the last sentence of the first paragraph in reference to Dr. Haldane—"His death is a severe loss to the whole mining community"; whilst it also refers to the retirement of Prof. S. M. Dixon, who, as is well known, has rendered much valuable service in connexion with wire ropes used in mining. There is further a number of appendixes to the Report, one of which deals with protective equipment, and it is interesting to note that, generally

speaking, protective equipment has been largely adopted by the miners themselves. It is worth knowing that Great Britain is not the only country adopting protective equipment, the article by Leprince-Ringuet on miners' hats appearing in the *Annales des Mines* of Paris proving this point. The various representatives of the local committees are doing good work in popularizing the use of protective equipment, and the subject of falls of ground is making fair progress, considering the inherent difficulties of the subject.

### Radio Relay Services

RADIO relay is much more common abroad, where it is regarded as a public service, than in Great Britain. In a pamphlet written by G. S. Lucas and E. S. Hall of the Research Department of the British Thomson-Houston Co., Ltd., a description is given of the radio relay equipment built and designed for the Midland Relay Services, Ltd. It is suitable for 300 subscribers but could easily be adapted to suit 1,000 or more subscribers. It has four radio receivers with their aerial equipment, and a short-wave receiver. The aerial equipment depends upon the locality and conditions of reception. For the installation carried out at Rugby, two vertical aerials about 25 feet in length are used for local reception. For long-distance work a horizontal aerial 100 feet long and 50 feet high is used. For use on short-wave reception a special *V* doublet aerial has been installed. Two of the receivers are suitable for B.B.C. transmission and two for long-distance Continental programmes. The advantages offered to the public by this service are the replacement of aerials by simple overhead wires. The installation of only a simple speaker unit in the house is required; no power supply or battery is necessary. The main control station is under constant supervision and the receivers are adjusted for the best working conditions. The radio relay station is capable of relaying two or three independent programmes to all subscribers. All the vital points of the system are duplicated and the organization can deal quickly and effectively with faults and complaints as they arise.

### Telephone Development in Birmingham

A LARGE and imposing building called Telephone House has been built in Birmingham to accommodate the telephone equipment for the city and also the Post Office and engineering and administrative staffs. A description of the telephone equipment required for the trunk, toll and central exchanges which were installed by Siemens Brothers and Co., Ltd., of Woolwich, to the order of the Post Office, is given in the September supplement of the *Siemens Magazine*. The introduction of the maximum fee of one shilling for three minutes on all inland trunk calls made after 7 o'clock in the evening has made the trunk service very popular, and the more recent introduction of a half-crown maximum for a three minute trunk call between any two places on the mainland of Great Britain will still further increase the amount of trunk traffic. Outside London, Birmingham is the most important telephone centre in Great Britain. It is connected by direct trunk lines with all other zone centres and, in addition, forms an important link in the alternative trunk routes between London and other zone centres such as Liverpool, Manchester, Leeds, Sheffield, Nottingham and Leicester. The new trunk and toll equipment has been planned to meet the long distance (trunk) and the short distance (toll) traffic anticipated in the Birmingham district during the next few years. Since 1930 the development of the trunk traffic has exceeded all expectations. There have been installed in the building 367 switchboards, and in addition a centralized manual board for the whole of the Birmingham area. In the same building also a 5,700 line full automatic equipment for the central exchange is being installed. Two motor generator sets driven from the 400 volt 3 phase 50 cycle public supply mains, with an output of 1,600 amperes at 57 volts, are being used.

### Research in Mental Diseases

THE Annual Report, 1935–36, of the Joint Board of Research for Mental Disease of the City and University of Birmingham contains an account of much painstaking and laborious work (Birmingham: The University, 1936). The occurrence and distribution of 80 named varieties of micro-organisms are tabulated; 6,565 specimens were examined. Somewhat optimistically the report claims to have solved the problem of the cause of mental disease, since "it appears that mental disorder cannot be classed as an infectious disease, nor as a metabolic disorder, but that it is a *clinical resultant* of infectious and metabolic disorders acting during any period of the ante- and post-natal life of the individual, thus determining the character and onset of the mental symptoms". Also, "The functional disturbances of the central nervous system responsible for the symptoms of mental disorder, can be clinically and pathologically associated with local disturbances of the vascular supply to certain vital centres of the brain". It is true that the pathology of some brain diseases that cause mental disorder is well established, for example, encephalitis, syphilis, tumours; but there still remains a host of disorders, ranging through hysteria and the anxiety and obsessional states to schizophrenic personalities, and cyclothymia or manic-depressive conditions and paranoia, that have so far defied the laboratory expert.

### False Killer Whales in South Africa

DR. LEONARD GILL, in the Report of the South African Museum for the year 1935 (1936, p. 10), recounts another of those mass strandings of *Pseudorca crassidens* which have become so frequent since the reappearance of the species in the Dornoch Firth. The school came ashore at Mamre, about fifty miles north of Cape Town, and the occurrence was peculiar because of the large number of whales stranded, about three hundred, and because they came ashore not on sand but on jagged rocks. But a common feature of the strandings has been, as here, that the whales appear to have been trapped by a falling tide in channels cut off from the open sea by sand-banks. The Mamre stranding took place

towards the close of 1935, and seven years before, about the same time of the year, the first record of the species in African waters was made when about a hundred came ashore at Kommetjie, some sixteen miles south of Cape Town.

### Canadian Reindeer Herd

THE introduction of a herd of reindeer to Canada as an addition to the food resources of the far north has met with success. Notwithstanding the severity of the winter, the herd on its winter range east of the delta of Mackenzie River in the Northwest Territories is reported by the Office of the High Commissioner to be in good condition, and to number about 3,000. Surplus males to the number of 200 were slaughtered during the autumn and the carcasses used for food, while the hides were used for moccasins, mittens and other items of wearing apparel. The herd, accompanied by its herders, undertakes a regular north and south migration, moving northward along the arctic coast early in April and southward again in late autumn, grazing by the way over the hills and valleys of its reserve of 6,600 square miles.

### American Research Grants

PART 3 of volume 76 of the *Proceedings of the American Philosophical Society* contains the report for the first three years of its operation of the Committee on Research established by the Society. The Committee set apart 20,000 dollars in 1933, 45,000 dollars in 1934, 60,000 dollars in 1935, and 50,000 dollars in 1936. Ninety-eight grants have been made of the average value of 1,500 dollars: sixteen in zoology, fourteen each in physics and botany, ten in astronomy, nine each in geology and physiology, six in chemistry, five in archæology and smaller numbers in other subjects. These grants are more generous than those made by the National Research Council but are less than those made by some of the great foundations. The Committee proposes to hold each year an autumn meeting at which the reports of grantees as to the progress of their researches will be read. The Committee would welcome suggestions for improving its methods of aiding research.

### Research Grant Board, South Africa

THE recently issued report of the Research Grant Board, Union of South Africa, covers the period 1918–35. The Board was established in October 1918 as a result of a recommendation of the Advisory Board of Industry and Science, which had been formed earlier that year from an amalgamation of the Industries Advisory Board and "a Scientific and Technical Committee". It was at first proposed that the Research Grant Board should be attached to the Department of Agriculture, but after forming a sub-committee of the Advisory Board until the dissolution of the latter in 1923, it was attached to the Department of Mines and Industries until 1933, when it was transferred to the newly-formed Department of Commerce and Industries. While attached to one Department, the Board is regarded as serving all branches of Government, recognition being given to this relationship by the presence on the Board of assessor members from other Departments. Initially, the Board's activities were confined to the encouragement of research in universities and museums, but its scope was speedily extended to embrace every branch of knowledge and to include the whole country irrespective of institutions.

ONE of the most important functions of the Board is the administration of Government grants in aid of research as well as research scholarships. It has also undertaken similar duties on behalf of the Carnegie Corporation of New York, which has allocated generous funds for research in South Africa. As at first constituted, the Board consisted of representatives of science and industry, together with the assessor members from Government Departments. When its scope was enlarged, members were added to represent other than scientific subjects. While ordinary members of the Board have been chosen with an eye to representation of all the interests concerned, they are regarded as serving wholly in their individual capacity and responsible only to the Minister. The success and efficiency of the Board are attributed largely to this arrangement and to the spirit of unity it engenders, and also to the excellence of its personnel and the unstinted manner in which they have given of their best to the work.

### Carnegie Institution of Washington

THE report of the president of the Carnegie Institution of Washington for the year ending October 31, 1935, refers to developments in methods and organization of research in the Institution, particularly in the support of larger projects and the co-operation of fair-sized groups of individuals, as in the Geophysical Laboratory, Mount Wilson Observatory and the Department of Genetics. Its present organization is adapted not only to the advance of knowledge in new interlocking or overlapping areas of research, but also to bring back to each of the groups engaged upon special problems a wide range of materials otherwise not readily secured. Reference is made in the report to the progress of seismological research and of the investigations on terrestrial magnetism. Astronomical work has included study of the nova in Hercules, of stellar atmospheres, extra-galactic nebulæ, measurement of the velocity of light and observations of sunspot activity. Assistance has been given to research on cosmic rays and on the hydrodynamics of the atmosphere and major climatic variations. Numerous investigations have been carried out by the Department of Plant Biology, including the study of the influence of climatic environment on the life and development of living organisms, and by the Division of Animal Biology which includes the Department of Embryology, the Nutrition Laboratory and the Department of Genetics. Of outstanding interest are the activities of the Division of Historical Research, established in 1929, which has provided the opportunity to study history as science, art, culture, sociology and government in all phases with the application of scientific principles to the collection of materials and to the interpretation of the data

acquired. The rapprochement of scientific and cultural or human interests in this way is an outstanding achievement of the Institution.

### Conference on College Hygiene

THE second National Conference on College Hygiene of the United States will be held in Washington, D.C., on December 28–31 under the joint sponsorship of the American Student Association, the National Health Council and the President's Committee of Fifteen on College Hygiene. There will be no formal programme, but the work will be divided into five sections devoted respectively to health service, health teaching, organization and correlation, special problems and relationship of college hygiene to training and secondary education. Dr. Livingston Farrand, president of Cornell University, from whom further information can be obtained, is chairman of the Conference.

### *Indian Science Abstracts*

THE National Institute of Sciences of India has recently issued the first number of *Indian Science Abstracts*, an annotated bibliography of science in India, including abstracts of all papers published in India or abroad on work done in India or based on Indian material. The first part includes abstracts arranged tentatively under nine headings. To ensure continuity under each heading and to facilitate reference, the abstracts dealing with each science have been given a separate pagination with the serial number of the heading preceding it. The abstracts in each section are arranged alphabetically and numbered serially. The general editor is Dr. Baini Prashad, who is assisted by nine associate editors for different subjects.

### Announcements

DR. HANS VON EULER-CHELPIN, professor of organic chemistry at Stockholm, has been elected an honorary member of the Association of German Chemists; the Justus Liebig Medal of the Association has been awarded to Dr. Gustav Hittig, professor of inorganic and analytical chemistry at the German Technical University at Prague; and the Carl Duisberg Memorial Prize to Dr. Rudolf Tschesche, of Göttingen.

A PRIZE of 1,000 dollars is offered by the Williams and Wilkins Publishing Company for the best work on a science subject presented before July 1, 1937. The work must be in English and the desired length is 100,000 words. Further information can be obtained from the Company, Mt. Royal and Guilford Avenue, Baltimore, Maryland.

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, Harpenden, Herts, and other members of the staff, are prepared to give a few lectures to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted experiments. Among the subjects offered are: manures, fertilizers, soil micro-organisms (Bacteria, Protozoa, etc.), agricultural botany, agricultural chemistry, soil physics, entomology, and plant pathology. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

MR. W. J. HALL, of Walsall, who was formerly with the Wool Industries Research Association at Leeds, and later with British Celanese Ltd., has been appointed technical editor of the *Journal of the Textile Institute*.

MESSRS. ADLARD AND SON, LTD., presented to members of the British Association at Blackpool a handy pocket diary, the main part of which consists of a calendar (September 1936–July 1937) of the meetings of scientific societies. Copies of the little book can be obtained from Messrs. Adlard at 21 Hart Street, London, W.C.1, price 6*d*.

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APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A principal of Llanelly New Mining and Technical Institute—The Clerk of the Education Committee, County Education Offices, Carmarthen (September 28).

An assistant lecturer in mathematics in the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield (September 30).

An assistant lecturer in metallurgy in University College, Swansea—The Registrar (September 30).

An assistant (Grade III) in the Air Ministry Scientific Pool, for service at the Royal Aircraft Establishment, South Farnborough—Chief Superintendent, Royal Aircraft Establishment, quoting Ref. A.248 (October 2).

An assistant keeper on the higher technical staff of the Science Divisions of the Science Museum—The Director, Science Museum, South Kensington, London, S.W.7 (October 12).

An assistant county dairy instructor for Hampshire—County Agricultural Organizer, The Castle, Winchester (October 12).

A chemist in the Aeronautical Inspection Directorate Test House, Kidbrooke (non-metallic materials section, oils and petrols sub-section)—Secretary, Air Ministry (S.2.d.), Adastral House, Kingsway, W.C.2 (October 24).

A director of the Kanematsu Memorial Institute of Pathology, Sydney Hospital, N.S.W.—Secretary, Universities' Bureau, 88a Gower Street, London, W.C.1 (January 31).

Assistants to civil and mechanical engineers in the Ordnance Factories, E.D.(F.), Royal Arsenal, Woolwich, S.E.18—The Chief Superintendent.

A male junior assistant chemist at the Royal Gunpowder Factory, Waltham Abbey, Enfield Lock, Middlesex—Principal Clerk.

Temporary assistant civil engineers in the Air Ministry—Secretary (W.B.9), Room 712, Adastral House, Air Ministry, Kingsway, W.C.2, by post-card for form of application.

A male laboratory assistant (Grade II) at the Experimental Station, Porton, near Salisbury, of the War Department—Commandant of the Station.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 552.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Oxygen Content of the Stratosphere

AIR from different heights of the stratosphere was brought down by registering balloons by means of a new device for air sampling. As the apparatus was protected against the low air temperature in the stratosphere by a "Cellophane" case, it was possible to employ ordinary stop-cocks. At the desired heights the latter were operated by an electrical arrangement actuated by aneroids. The glass vessels for air sampling were constructed so that the oxygen content could be determined in them by means of heating metallic copper without it being necessary to change the vessel. Before and after heating the copper the volume was brought to the same level, so that the diminution of pressure divided by the initial pressure immediately gives the oxygen content.

The following table gives the values obtained for the oxygen contents:

| Date | Height (km.) | Oxygen content (per cent by vol.) |
|---|---|---|
| 24. 8.36 | 0 | 20·92 ± 0·02 |
| 19.12.35 | 14·5 | 20·89 ± 0·05 |
| 5.12.35 | 18·5 | 20·84 ± 0·02 |
| 18. 8.36 | 19 | 20·87 ± 0·02 |
| 5.12.35 | 22·2 | 20·57 ± 0·05 |
| 12. 2.36 | 24 | 20·74 ± 0·02 |
| 6. 5.36 | 28–29 | 20·39 ± 0·05 |

In approaching the height of 20 km. the oxygen content is diminished noticeably in comparison with the value at the earth's surface (20·90–20·95 per cent); above 20 km. the diminution begins to be more pronounced; at the greatest height there is a deficit of 2–3 per cent of the oxygen content. The values agree with the determination of the helium content of the stratosphere by F. Paneth[1], who at a height of 21 km. finds a helium surplus of 8 per cent.

It is remarkable that at heights greater than 20 km. the values differ rather considerably. This is probably due to the weather conditions. In air masses of polar origin it seems that the diffusive separation begins at lower heights than in equatorial regions where the top of the troposphere is remarkably higher. The insolation in equatorial regions is very much stronger, and the turbulence of the atmosphere reaches to greater heights. Lepape and Colange[2] also find that the content of helium plus neon in the stratosphere is slightly increased, and more variable than on the earth's surface. If my assumption is true, then the height of the ozone layer in the stratosphere should also be lower in polar regions than in equatorial regions, first, because the oxygen content in polar regions decreases with heights more rapidly than in equatorial regions, and secondly—which is perhaps of even greater effect—because the greater stability of the atmosphere in the polar regions tends to increase the diffusion of the heavy ozone downwards.

A more detailed report will be published shortly in *Luftfahrtforschung*.

E. REGENER.

Physikalisches Institut der Technischen Hochschule, Stuttgart.
Sept. 6.

[1] F. A. Paneth and E. Glückauf, NATURE, 136, 717 (1935).
[2] A. Lepape and G. Colange, NATURE, 137, 459 (1936).

## Absence of Cosmic Rays from Nova Lacertæ

THE appearance of Nova Lacertæ gave us a second opportunity of investigating whether the conclusion at which we arrived when investigating the relation of Nova Herculis to cosmic rays[1], namely, that no cosmic rays emitted from novæ are observable, was correct or not. For this purpose we have turned the centre line of the field of our apparatus (field of the apparatus: 40° in east-west, 10° in north-south direction; 36 cm. lead between the counters) as soon as the outburst of the nova was signalled, into such a position that the centre line showed only an angle of 2° 09′ north of the nova at culmination. In such a position a set of measurements was performed from June 19 until July 17, 1936.

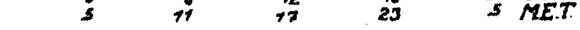



FIG. 1. Variation of cosmic ray intensity (average values) with sidereal time (S.T.) and Central European time (M.E.T.). The horizontal straight line above the diagram indicates the time during which Nova Lacertæ passed through the field of our apparatus, and the arrow the time of its culmination.

Fig. 1 shows the average variation of the intensity for the different hours of the day, as a percentage of the mean value. As can be easily seen, the curve indicates only the well-known diurnal variation, and no increase at the time of culmination of the nova. The assumption that no effect of the nova was detectable, because its cosmic radiation was of much shorter period than the duration of the measurement, cannot be maintained, for even the ratio of the

intensity during the culmination of the nova for a single day to the mean value of the daily intensity in no case exceeded twice the error of measurement.

This confirms our previous experience with Nova Herculis, as in neither case could an influence of undeflected cosmic rays originating in the nova be detected.

J. BARNÓTHY.
M. FORRÓ.

Institute of Experimental Physics,
University,
Budapest.
Aug. 13.

[1] J. Barnóthy and M. Forró, NATURE, 135, 618 (1935). Z. Phys., 94, 773 (1935). NATURE, 136, 680 (1935).

## Resonance Levels for Absorption of Neutrons

WHEN a very thin layer of boron is irradiated with slow neutrons, the number of α-particles emitted can be represented by an expression proportional to $\Sigma n^i\alpha^i + P$, where the terms $n^i\alpha^i$ correspond to the nearly homogeneous groups of neutrons absorbed selectively in certain elements; $n^i$ is the number of neutrons having kinetic energy $E^i$, and $\alpha^i$ is their coefficient of absorption in boron. The most important term represents the group of 'thermal' neutrons, called by Amaldi and Fermi[1] the group $C$. If we absorb this group in a thin sheet of cadmium, the number of α-particles emitted by boron diminishes by an amount proportional to $a^C n^C \alpha^C$, where $a^C$ is the fraction of the group $C$ absorbed by cadmium. Similarly, let us suppose that we absorb another group, $J$, in a suitable element; the corresponding decrease of the number of α-particles will be proportional to $a^J n^J \alpha^J$. If, therefore, the relative numbers of groups $C$ and $J$ and the fractions $a$ are known, we can determine the ratio $\alpha^C/\alpha^J$, which is equal to $\sqrt{E^J/E^C}$. In this way the energy corresponding to the resonance level of the element $J$ can be calculated.

I have used a boron-coated ionization chamber connected to a Hoffmann electrometer. The chamber was surrounded with paraffin wax and irradiated with slow neutrons from a source of polonium and beryllium equivalent in strength to 10 mgm. of radium. The ionization currents were measured (1) with unfiltered radiation; (2) with neutrons filtered through 0·5 mm. of cadmium; and (3) 0·5 mm. of cadmium and 0·1 mm. of silver. The results are as follows:

| Filter | none | 0.5mm.Cd | 0·5mm.Cd+0·1mm.Ag |
|---|---|---|---|
| Ionization | 4·0465 | 0·3285 | 0·3145 |

Owing to the smallness of the effect due to absorption of neutrons in silver, a very great number of measurements has been made so that the statistical errors were about ten times smaller than the differences to be measured. We have

$$\frac{a^A n^A \alpha^A}{a^C n^C \alpha^C} = \frac{0\cdot014}{3\cdot718} = 0\cdot00376.$$

The relative numbers of groups $A$ and $C$ and their coefficients of absorption in cadmium and in silver have been determined by Fermi and Amaldi. As it was, however, to be expected that the numbers may depend on the geometrical arrangement, thickness of paraffin, etc., special experiments have been made in order to compare directly $a^A n^A$ and $a^C n^C$. The boron layer has been removed, and a silver foil of 0·05 thickness exposed in its place, all other conditions remaining unchanged. The activity of the foil, due to the isotope of 22 sec. period, was measured by means of a Geiger counter. If $a$ is the activity obtained with unfiltered radiation, $b$ that with neutrons filtered through 0·5 mm. of cadmium, and $c$ that with neutrons filtered through 0·5 mm. of cadmium and 0·1 mm. of silver, then

$$a = 1490, \quad b = 1134, \quad c = 344.$$

If $r^A$ and $r^C$ are the fractions of the total number of neutrons absorbed in the silver foil, we have

$$\frac{a^A n^A r^A}{a^C n^C r^C} = \frac{1134 - 344}{1490 - 1134} = \frac{790}{356} = 2\cdot2.$$

The fraction $r^A/r^C$ can be calculated using the known values of absorption coefficients of silver for the groups $A$ and $C$. I find

$$r^A/r^C = 53\cdot6, \text{ and hence } a^A n^A / a^C n^C = 0\cdot041.$$

According to Amaldi and Fermi, $n^A/n^C = 0\cdot016$. Considering that $a^A/a^C < 1$, we see that under the conditions of my experiment, group $A$ appears to be very prominent. This may be due to the special arrangement used, or to the fact that the brass walls of the ionization chamber absorbed a considerable fraction of thermal neutrons. For the ratio of the coefficients of absorption in boron, I find finally

$$\alpha^C/\alpha^A = 0\cdot041/0\cdot00376 = 10\cdot9\,;$$

and for the energy ratio

$$E^A/E^C = 117\,;\ E \cong 3 \text{ e.v.},$$

in good agreement with determinations of Preiswerk and Halban[2].

Similar experiments performed with gold have given $E^{\mathrm{Au}} \cong 4\cdot5$ e.v. In the case of iodine, using as absorber a sheet of potassium iodide of 1 gm./cm.[2], I could not find any diminution of the ionization current. This shows, in agreement with the determinations of other workers, that the resonance level of iodine is essentially higher than that of silver and gold. It should be noticed that Collie[3] has applied a similar method, but obtained definite results only in the case of indium.

J. ROTBLAT.

Laboratory of Atomic Physics,
Free University of Poland,
Warsaw.
August 10.

[1] Amaldi and Fermi, Ric. Scient., 2, 544 (1935).
[2] H. v. Halban, jun. and P. Preiswerk, NATURE, 137, 905 (1936).
[3] C. H. Collie, NATURE, 137, 614 (1936).

## Destruction of Supraconductivity by Electric Current and Magnetic Field

BY any change of the magnetic flux through a supraconducting ring a permanent current $T$ is induced, the strength of which can be calculated from the field intensity in the centre of the ring, taking into account the field deformation caused by the magnetic properties of the supraconducting ring.

In Fig. 1, $T$ is plotted against the external field intensity $H_e$ for a ring of tin. This curve, which limits the region of supraconductivity ($\rho = 0$), is given by the condition that the sum of the tangential component of the external field and the field caused by the current is equal to the critical magnetic field, either on the inside or on the outside periphery of

the ring, while the field is certainly smaller on the rest of the ring surface. Thus our experiments show that it is a necessary condition of supraconductivity, that the magnetic field is zero in the whole of the volume and its effective tangential component does not exceed the critical value at any point of the surface of the supraconductor.

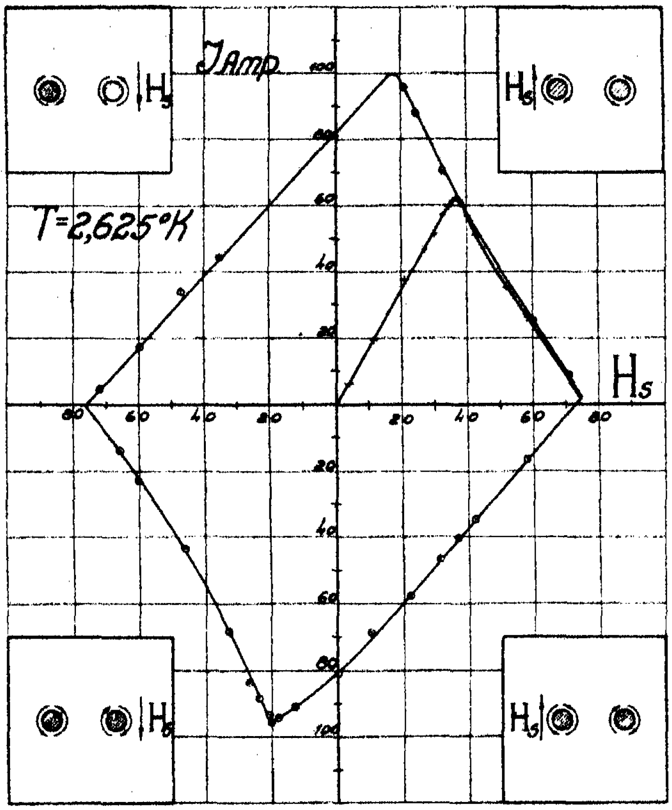



FIG. 1.

In a paper just published by D. Shoenberg[1], the results of measurements on a supraconducting ring of lead are given which are entirely in agreement with our results obtained with tin. But Shoenberg's conclusions are wrong, since he assumes that the decrease in current could be explained by a decrease in the supraconducting cross-section which leads to an unstable condition of current distribution. A more detailed paper on this matter is being published shortly[2].

L. SHUBNIKOV.

Ukrainian Physico-Technical Institute,
Kharkov.
July 15.

[1] D. Shoenberg, *Proc. Roy. Soc.*, A, **155**, 724 (1936).
[2] *Sow. Phys.*, in print.

## Influence of Nitric Oxide on the Thermal Decomposition of Dimethyl Ether. Gaseous Catalysis

IN the course of an investigation on the thermal decomposition of dimethyl ether, alone, and in the presence of other gases, the reaction with nitric oxide was studied. We found that very small quantities of the oxide reduced the rate of reaction, represented by the equation,

$$(CH_3)_2O = CH_4 + CH_2O,$$

and measured by the rate of formation of methane, to a very small fraction of the rate observed in the pure gas. This is in accord with the results of Staveley and Hinshelwood[1] in the case of diethyl ether.

As the concentration of the nitric oxide in the reaction mixture is increased, the rate of reaction, which had become very small, increases rapidly. Staveley and Hinshelwood, writing of the reaction in the case of diethyl ether, refer to this process as one of catalysis. In the case of dimethyl ether, however, investigation by the method of detailed analyses shows that catalysis is not involved.

The $CH_4$–$t$ graphs, representing the rate of primary decomposition of dimethyl ether, bend less sharply towards the $t$-axis than they should do if the decomposition process followed a normal course in accordance with the classical theory. The graphs show well-marked breaks, and the rate of reaction is diminished by increasing the surface of the reaction vessel. It appears to be an important fact that the process can only follow a single course, and there are no alternatives such as have been indicated in the case of other processes[2].

If a series of experiments is carried out, within the range at which the presence of nitric oxide increases the rate of reaction, such that the initial concentrations of the dimethyl ether and nitric oxide, and the temperature, are constant, and the time is varied, it is found that the whole process has no relation to the process involved in the primary decomposition of dimethyl ether alone. The products are methane, carbon monoxide and dioxide, with very little hydrogen, and, at high concentrations of nitric oxide, carbon monoxide is the dominant product. The form of the $x - t$ graphs is quite different from those recorded in the case of the primary decomposition of dimethyl ether alone. They are convex towards the $t$-axis, as in the case of the thermal decomposition of acetaldehyde. The processes involved are strongly accelerated.

The processes are obviously oxidation processes, and the observations now recorded support the suggestions put forward in the two letters to NATURE referred to above. It seems that the reaction of nitric oxide with dimethyl ether gives rise to processes, each of which results in the formation of a short-lived intermediate, which can decompose in two different ways. The oxidation processes can be represented by a series of equations, such as,

$$(1)\quad CH_3.O.CH_3 + O \rightarrow CH_3.O.CH_2OH \begin{cases} CH_4 + CO_2 + H_2 \\ CH_4 + CO + H_2O \end{cases}$$

$$(2)\quad CH_3.O.CH_2OH + O \rightarrow CH_3.O.CH(OH)_2 \begin{cases} CH_4 + CO_2 + H_2O \\ CH_3OH + CO + H_2O. \end{cases}$$

In a series of experiments in which a quantity of dimethyl ether was heated with increasing quantities of nitric oxide for 15 minutes, the proportion $(CO_2 + CO) = 2CH_4$ was reached.

Since the characteristics of these oxidation processes are almost identical with those of the thermal decomposition of acetaldehyde, it is not surprising that nitric oxide does not influence the rate of thermal decomposition of acetaldehyde in the manner observed in the case of dimethyl ether. The so-called catalysis of the thermal decomposition of acet-

aldehyde by nitric oxide is also probably initiated by oxidation processes. The inhibition of the thermal decomposition of dimethyl ether by nitric oxide is, however, a very important addition to those facts which we have enumerated, which serve to distinguish this process from the thermal decomposition of acetaldehyde. Taking all these facts together, it does not seem possible to distinguish either process as being the only one which is influenced by chain mechanism.

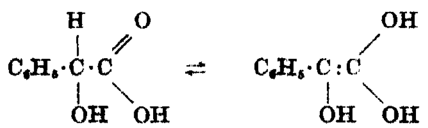
P. F. GAY.
MORRIS W. TRAVERS.
Chemistry Department,
University of Bristol.
August 31.

[1] *Proc. Roy. Soc.*, A, **154**, 335, and *J. Chem. Soc.*, 812 (1936).
[2] NATURE, **137**, 906 (1936); **138**, 26 (1936).

## Use of Deuterium as an Indicator in Stereochemical Investigations

1. IT is known that optically active compounds under different influences undergo racemization. Various theories have been put forward to explain the mechanism of these changes.

A. Werner[1] took the view that the extreme oscillation of the molecules led apparently to an unravelling of the tetrahedral configuration. Other authors assume that the racemization is brought about through the formation of an enol[2]. Taking as an example mandelic acid, it is assumed that the following equilibrium goes over from the keto-form to the enol-form; that is, there is a change from an asymmetrical to a symmetrical molecule:



The use of heavy water ($D_2O$) enabled us to decide experimentally between the various opinions, for we know from other examples[3] that the OH group of the enol-forms is exchanged with $D_2O$. If the racemization in heavy water takes place through the enol-form, then the racemized mandelic acid will show a corresponding high content of the D-atom.

In the control experiment, mandelic acid was recrystallized out of heavy water by heating to 60° C., an operation in which the optical activity is fully retained. The resulting mandelic acid contained, according to isotope analysis[4], $x = 1\cdot7$ D-atom (corresponding to $t = 1\cdot9$)[5], which corresponds to an exchange of two hydrogen atoms.

This result was confirmed by many experiments and is explained by the formation of the acid

$$C_6H_5\overset{\displaystyle H}{\underset{\displaystyle OD}{C}}\cdot COOD.$$

In the racemization experiment, mandelic acid, dissolved in heavy water, was warmed to a temperature of 140° C. over a period of 51 hours. The acid isolated was optically completely inactive. The isotope analysis of the racemized mandelic acid, carefully purified, freed from all traces of benzoic acid, gave, however, $x = 1\cdot7$, $t = 1\cdot9$ also, corresponding to two interchangeable hydrogen atoms, although if we assume enolization, at least $t = 2\cdot7$ was to be expected. This result, accordingly, is in favour of the Werner-Hund conception of the mechanism of racemization.

A racemization experiment with a mandelic acid in a solution of NaOD also resulted after 16 hours heating at a temperature of 100° C. in a fully racemized acid. Purified and recrystallized from $D_2O$, the isotope analysis of this acid gives $x = 2\cdot06$, $t = 2\cdot34$.

Since the value of $t$ here is again less than $2\cdot7$, it cannot be supposed that racemization and enol formation is the same reaction.

2. There exist the results of a series of experiments concerning the preparation of compounds of the type $C.R'R''HD$. These communications are partly of negative[7] content and partly positive[8]. In this paper we only want to report on two such experiments. We allowed benzene to react with the optically active compound

$$C_6H_5\cdot\overset{\displaystyle Br}{\underset{\displaystyle H}{C}}\cdot COOH,\ [\alpha]_D^{20} = -145° \text{ (benzene)}$$

in the presence of zinc; the resulting acid,

$$\begin{matrix} C_6H_5 \\ C_6D_5 \end{matrix}\!\!\Big\rangle CH\cdot COOH,$$

was optically inactive.

Experiments in which an attempt was made to split up the acid with the aid of alkaloids have also not succeeded in obtaining one isomer from the separated alkaloid salt and its antipodes from the mother liquor. All observed rotation of the plane of polarized light could be traced to impurities. Further experiments are still in process.

However, we have shown with $l$-mandelic acid that the substitution of H by D in an optically active molecule can have an influence on the optical rotation. When $l$-mandelic acid, which is not subject to racemization at 60° C.[9], was allowed to react with heavy water at that temperature, it showed $1\cdot7$ D-atoms by the isotope analysis. The measurement of the optical activity of this acid (D) and of the original, untreated $l$-mandelic acid (H), both in dry acetophenone, gave the following results:

| | H | D |
|---|---|---|
| $[\alpha]_D^{20}$ | $-179\cdot10° \pm 0\cdot13$ | $-173\cdot27° \pm 0\cdot13$ |
| $[\alpha]_{Hg}^{20}$ | $-216\cdot84° \pm 0\cdot13$ | $-211\cdot43° \pm 0\cdot13$ |

The complete communication will appear in the *Helv. chim. Acta*.

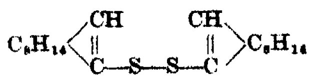
H. ERLENMEYER.
H. SCHENKEL.
A. EPPRECHT.
University,
Basel.
July 21.

[1] A. Werner, "Stereochemie", 49 (1904); see also F. Hund, *Z. Phys.*, 43, 805 (1927).
[2] A. McKenzie and H. Wren, *J. Chem. Soc.*, **117**, 680 (1920); T. A. Smith, *Ber.*, **64**, 430 (1931); Th. Wagner-Jauregg, "Stereochemie" (Freudenberg), 858 (1933).
[3] See A. Farkas, "Orthohydrogen, Parahydrogen and Heavy Hydrogen", 200 (1935); H. Erlenmeyer, A. Epprecht, H. Lobeck and H. Gärtner, *Helv. chim. Acta*, **19**, 354, 543 (1936).
[4] H. Erlenmeyer and H. Gärtner, *Helv. chim. Acta*, **19**, 129 (1936).
[5] The difference from the value 2 is caused by the rates of dissociation; see *Helv. chim. Acta*, **19**, 354 (1936).
[6] W. F. K. Wynne-Jones, *Chem. Rev.*, **17**, 122 (1935).
[7] H. Erlenmeyer and H. Gärtner, *Helv. chim. Acta*, **19**, 145, 331 (1936); J. B. M. Coppock and S. M. Partridge, NATURE, **137**, 907 (1936).
[8] E. Biilmann, K. A. Jensen und E. Knuth, *Ber.*, **69**, 1031 (1936); J. R. Clemo and S. McQuillen, *J. Chem. Soc.*, 808 (1936); *Chem. and Indust.*, **55**, 441 (1936).
[9] Rothe, *Ber.*, **47**, 843 (1914).

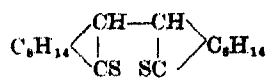
### Synthesis of Two Isomeric *bis*-Thiocamphors

IN continuation of his researches on thiocamphor[1] reported in this journal, and also published in the *Journal of the Indian Chemical Society*, Mr. D. C. Sen, working in my laboratory, has recently made some interesting observations which, with his views concerning the constitution of the compounds isolated, are reported below.

*Bis*-thiocamphor has been synthesized by the action of iodine on the sodio derivative of thiocamphor. It may be represented by either (A) or (B).



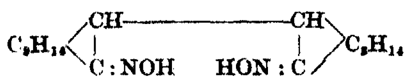
(A)



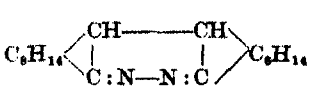
(B)

It has not been possible to synthesize this compound by Oddo's method[2] of synthesis of *bis*-camphor, namely, by the action of sodium or magnesium on β-bromocamphor, as β-bromothiocamphor could not be isolated in the pure state. Incidentally, the synthesis of *bis*-camphor by this method was also tried, but it resulted in the formation of β-iodocamphor instead of *bis*-camphor. *Bis*-thiocamphor has been prepared by the above method in two stereoisomeric forms (*l*- and *dl*-) from *l*-thiocamphor and *dl*-thiocamphor respectively.

*dl*-*Bis*-thiocamphor, m.p. 164°, forms a dioxine, m.p. 199° (*d*) and an azine, m.p. 176°, whereas *l*-*bis*-thiocamphor, m.p. 180°, also forms an azine, m.p. 200°, under similar conditions. These facts, along with the analytical and molecular weight data of the two *bis*-thiocamphors and their derivatives, lead to the conclusion that they contain two C : S groups, and that they are 1 : 4-dithioketones, and have the formula (B). The dioxines and the azines should therefore be represented by the structures (C) and (D) respectively.



(C)



(D)

On reduction with aluminium amalgam in moist ethereal solution, *dl*-*bis*-thiocamphor forms *dl*-*bis*-thioborneol, m.p. 148°, which decolorizes iodine and forms a yellow lead salt.

*l*-*Bis*-thiocamphor has a very high molecular rotation $[M]_D^{30°} = -1100 \cdot 5$ in benzene solution, whereas the molecular rotation of *l*-thiocamphor is $[M]_D^{30°} = -41 \cdot 3$ in the same solvent, and under similar conditions. This high exaltation in optical activity may be attributed to the presence of a potential conjugated system in *bis*-thiocamphor, which may be effective both in the thio- and thiol- phases.

Studies in absorption spectra in the visible region of *bis*-thiocamphor at different dilutions and the comparison of these with those of thiofenchone and thiocamphor have given interesting results. It has been noticed that a 5·4 per cent solution of bis-thiocamphor in benzene manifests a characteristic absorption band between 5270 A. and 4530 A., and that with dilution this band becomes shorter, and at 2·7 per cent concentration it gives a very short band, having the centre at 4950 A. Similar bands have also been observed in the case of *l*-thiocamphor and *d*-thiofenchone. This selective absorption band is therefore a characteristic property of the C : S group in cyclic thioketones, which is definitely chromophoric.

Further work in this line, which is in progress, will be published in detail in due course in the *Journal of the Indian Chemical Society*.

P. C. RÂY.

Palit Laboratory,
University College of Science and Technology,
Calcutta.

[1] NATURE, 134, 1010 (1934); *J. Indian Chem. Soc.*, 12, 647, 751 (1935).
[2] *Gazzetta*, i, 27, 149 (1897); *ibid.*, i, 41, 126 (1911); *Ber.*, 37, 1569 (1904).

### Non-Existence of Multiplanar Cyclohexane Rings

THE work done by us, so far, has shown that it is possible to isolate only two forms of 4-methyl-, 3-methyl- and 2-methylcyclohexane-1-carboxy-1-acetic acids[1] and one form of 3 : 3-dimethylcyclohexane-1-carboxy-1-acetic acid[2]. In order to get more evidence on the point of the configuration of the cyclohexane ring, we have now synthesized 4 : 4-dimethylcyclohexane-1-carboxy-1-acetic acid and 4 : 4-dimethylcyclohexane-1 : 1-diacetic acid from 4 : 4-dimethylcyclohexanone. Each one of them is found to exist in one form only, thus supporting the uniplanar structure of the cyclohexane ring. The work is not yet complete, but this notice has been necessary in view of the recent publication of Miller and Roger Adams on the same subject[3]. The full details of the work will be published in due course.

R. D. DESAI.
R. F. HUNTER.

Department of Chemistry,
Muslim University,
Aligarh, India.
August 23.

[1] *J. Chem. Soc.*, 416 (1936).
[2] NATURE, 136, 608 (1935).
[3] *J. Amer. Chem. Soc.*, 58, 787 (1936).

### Normal Erosion as a Factor in Soil Profile Development

IN NATURE of June 6, Prof. G. W. Robinson directs attention to the effects of lateral transport of surface soil material, moved in the course of ordinary slow denudation, on certain soils in Wales. Erosive processes of this kind not only modify the development of particular soil profiles, but also may be found governing the zonation of soil types over wide areas. I offer an example from tropical semi-arid country.

The diagram (Fig. 1) represents, with the horizontal scale much compressed, a residual granite hillock and the soils around it, in the plateau region south of Lake Victoria. Primary soil substance is made among the rocks from the products of mechanical

and chemical disintegration of the granite surfaces, together with plant debris, baboon and hyrax droppings, and the like residues. A shallow skeletal dark grey loam (1) is so formed. This works downhill by creep and slow erosion, to serve at the hill foot as the parent material on which a deeper soil (2) of the red earth group develops. At the base of the red earth profile, where there is temporary accumulation of seepage in the wet season, a clinker-like horizon (3), coarse granitic grit in a black and rusty ferruginous cement, begins to form and may in time attain a thickness of a metre or more. In the meantime, occasional storm-water running over the surface is gradually paring off the top soil, and the spoil travels differentially according to particle size, so that by cumulative effect a zone of washed sand (4) covers the footslope below, silty or clayey sand (5, 6) lies beyond it, and a level clay floor fills the bottom-land—the *mbuga* (7). These deposits may, if we will, be looked upon merely as so much parent material, put there geologically by the denudation process; but at all stages, the erosion having been slow and non-catastrophic, they have borne their appropriate vegetation and have been developing towards maturity as soils. At a late stage, as erosion works down towards base level, the abrasion of the red earth profile ends in the emergence of the clinker-like horizon at the lowered ground surface, where (commonly under the misleading name of 'surface laterite') it resists further erosion like the sill of a waterfall in the profile of a stream.

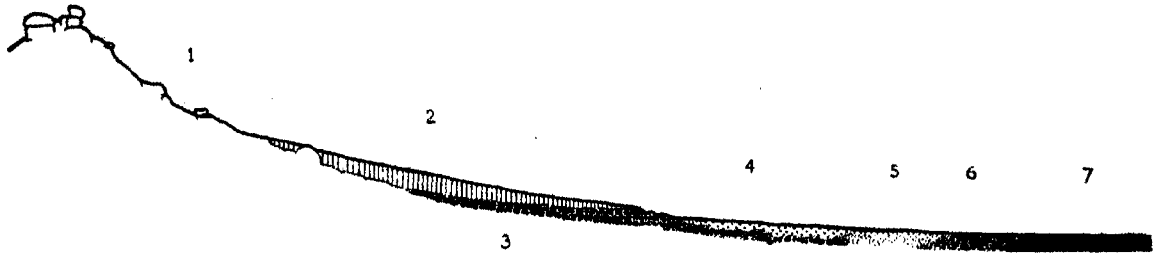



FIG. 1.

A zoned distribution of soil types in relation to the high points in a generally low relief, somewhat as in this example, is found over a great part of the central plateau or elevated peneplain region of Tanganyika. According to the maturity of the topography, or because a new cycle of erosion has been initiated tectonically, or for lithological reasons, the character and proportionate extent of the different soils vary locally, but some six or seven of the main types are of sufficiently general occurrence in their characteristic positions on the contours to have given rise to a well-developed soil nomenclature in the Sakuma language. The complete sequence can be found under seemingly 'virgin' deciduous forest and bush, though there can be little doubt that man has at some time or other usually been in occupation and, as a soil-tilling animal, has expedited the erosive process. The case is not thereby removed from the scope of Prof. Robinson's subject of 'normal' erosion, for primitive man should not be excluded from his due place amongst the natural factors in soil formation.

Does not this example, incidentally, point to an anomaly in the use to which the word *profile* has been put by soil students? To the geomorphologist, geologist or engineer, the profile of the ground would be the outline of my diagram. To the pedologist the profile is what he finds in depth at a selected point. The language of soil description lacks a suitable term having a cross-country dimension, and the want of it is felt as soon as soils are discussed in relation to the lie of the land, as in this matter of erosion. To help in such discussions the word *catena* has been adopted (Provisional Soil Map of East Africa, 1936), to describe a topographic complex of soils such as is represented in my example.

G. MILNE.

East African Agricultural Research Station,
Amani.
July 16.

## Centrifuging in Rotating Hollow Cylinders

THE method described in this note provides a quick and efficient means for the fractionation of highly disperse systems—including the larger proteins—using relatively moderate centrifugal forces. Furthermore, all necessary information about the sedimentation rate and the sedimentation equilibria of these systems can be obtained, samples for examination being taken before and after spinning. Many important biological agents (viruses, bacteriophages, antibodies, etc.) remained outside the scope of the admirable methods developed by Svedberg because they are not susceptible to direct continuous optical observation, but they are within the range of the new procedure.

The principal points upon which the new method is based are (1) to have the system spread as a thin film on the inner surface of a hollow cylinder rotating with its axis vertical; and (2) to have this film subdivided in two concentric layers, the inner one being liquid, the outer one a gel of a structure sufficiently coarse to permit free motion of the single particles. Thus the distance which the particles have to travel before entering the gel or before reaching the equilibrium distribution can be reduced to a few tenths of a millimetre, whilst the gel-layer provides automatic separation of the 'sediment' from the 'supernatant', or of two levels of the equilibrium distribution, when the rotation is stopped.

In the experimental work done so far, the 'closed bowl' of the Sharples-Super-Centrifuge (inner radius 2 cm., height 20 cm., speed up to 32,000 r.p.m.) has been used without modification. A solution containing 1–2 per cent agar (in water, broth, etc., for simple fractionation, in the suspension itself when sedimentation measurements were intended) was introduced into the warmed bowl and allowed to set with the centrifuge running; the suspension was

then introduced, and the spinning continued. Two per cent agar was used for particles less than 20 m$\mu$ in diameter and 1 per cent for those less than 60 m$\mu$ in diameter.

The assumption of free entrance and motion of the particles in these dilute gels appears to be justified so long as the particles in question are present in sufficiently high dilution, as is the case with most biological agents. With higher concentrations, however, the sedimentation may be hampered by a phenomenon related to the 'blocking' of filters. Therefore—working with serum for example—in spite of the small particle size, 1 per cent agar has been used. That adsorption plays no role in the effects obtained has been controlled by mincing the agar layer in the supernatant: the gel-free filtrate shows again the initial concentration.

The sedimentation in the very thin liquid layers used appears to be quite normal, and the calculation of the rate of sedimentation requires no elaboration here.

When the sedimentation equilibrium is established, the value of $k$, equivalent to $\frac{N}{RT} \cdot V(\sigma-\sigma_1)g$, in Perrin's equation can be calculated from the measured average concentration, $C_S$, in the liquid layer, and $C_W$ the average concentration in the whole system, liquid plus gel.

Now

$$C_S = \frac{1}{x_1} \cdot \int_0^{x_1} C_0 \,.\, e^{kx} \,.\, dx,$$

where $x_1$ = thickness of liquid layer.

$x_2$ = thickness of gel layer.

$C_0$ = equilibrium concentration when $x = 0$, that is, at the surface of the liquid.

$$C_W = \frac{1}{x_1+x_2} \cdot \int_0^{x_1+x_2} C_0 \,.\, e^{kx} \,.\, dx.$$

Hence

$$\frac{e^{kx_1}-1}{e^{k(x_1+x_2)}-1} = \frac{x_1}{x_1+x_2} \cdot \frac{C_S}{C_W}, \qquad (1)$$

$(x_1+x_2)$ being considered very small compared with the radius of rotation.

If $e^{kx_1} \gg 1$, then the solution of equation (1) is with good approximation.

$$k = \frac{1}{x_2} \,.\, \ln \,.\, \frac{x_1+x_2}{x} \,.\, \frac{C_W}{C_S}.$$

Otherwise the solution can be made very simple by arranging that $x_1 = x_2$, or that $x_1 = x_2/2$.

Working with the smallest bacteriophage, *S*13, for example, drops of 60–80 per cent in the concentration of the supernatant were found using 2·5 c.c. liquid and a centrifugal force of 10,000 × gravity, in 2–3 minutes time. This leads to a sedimentation constant of about $s = 5 \times 10^{-13}$. The 'molecular weight'—about 2–3 × $10^6$—obtained for this phage from the estimation of the sedimentation equilibrium using centrifugal forces of 2,500–10,000 × gravity is in good agreement with the value derived from the sedimentation rate.

In experiments made with Dr. Elford on Type I pneumococcus anti-serum (horse), 60–70 per cent of the antibody was spun down in thirty minutes (force, 20,000 × gravity); the drop in the total protein content determined refractimetrically was about 30 per cent. No further change was obtained by continued spinning. The calculation from this equilibrium leads to a value of about $4 \times 10^6$ for the 'molecular weight' of the antibody (corresponding to the globulin fraction of largest particle size). This confirms previous results obtained by Elford and his collaborators by filtration[1], and recent findings on concentrated purified antibody preparations using air-driven[2] and Svedberg centrifuges[3].

Besides the examples mentioned, the new method is being used in collaboration with Drs. Elford, Galloway and Andrewes for the purification of viruses and for the estimation of the specific gravity of viruses and bacteriophages. Some of the results have been mentioned at the Second International Congress for Microbiology. A more detailed account will be given later.

M. SCHLESINGER.

National Institute for Medical Research,
London, N.W.3.
Aug. 8.

[1] W. J. Elford, P. Grabar and W. Fischer, *Biochem. J.*, 30, 92 (1936).
[2] J. Biscoe, F. Herčík and W. G. Wyckoff, *Science*, 83, 602 (1936).
[3] M. Heidelberger, K. O. Pedersen and A. Tiselius, NATURE, 138, 165 (1936).

## Regeneration in Arachnida

DURING last year I noticed that Harvestmen (Opiliones) do not regenerate lost legs when they moult, and this summer I have determined that they do not regenerate pedipalpi either. It seemed possible that this surprising deviation from a general character of the Arachnida might be related to the contrast between the length of the limbs and the shortness of the cephalothorax, within which it would be impossible to develop a leg long enough to be useful when exposed by ecdysis, and that, if this were so, the same peculiarity might be shown by spiders with very long legs. A specimen of the spider *Pholcus phalangioides*, sent to me by Dr. W. S. Bristowe, has just cast its skin and shows no trace of a new leg to replace one which I removed four weeks ago.

Such failure to regenerate is, I think, a previously unrecorded feature among Arachnida, and it is intended to repeat the investigation with other spiders, such as *Phyllonethis* and *Tetragnatha*, which also have long legs.

THEODORE H. SAVORY.

Wentworth House,
Great Malvern.
Sept. 2.

## Chromosome Number of *Eucalyptus globulus* and *Eucalyptus Johnstoni*

WE have endeavoured to determine the chromosome numbers of certain species of *Eucalyptus*, using radicles, root tips and anthers. Although clear-cut mitotic figures were obtained with radicles and root tips, consistent with one another under different conditions of fixation and staining, we were not successful in determining the chromosome number with certainty, owing to the tendency of the chromosomes to remain attached to each other throughout the cycle.

Greater success was achieved with pollen mother cells, although here also the above tendency was to some extent troublesome. Diakinesis gave the most unambiguous results, but checks were obtained with metaphase I and anaphase I.

The haploid number for both *E. Johnstoni* and *E. globulus* is eleven. There appears to be an interesting tendency to secondary pairing in *E. globulus* which makes the determination of the number in metaphase I and anaphase I less certain than with *E. Johnstoni*; but the diakinesis figures seem conclusive.

Work is proceeding with the view of tracing the course of the whole meiotic series of changes. These show interesting variations from the normal.

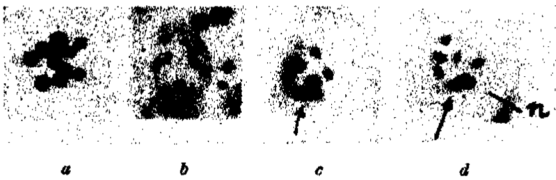



FIG. 1. (*a*) Metaphase I of *E. Johnstoni*. × 2000. (*b*) Late diakinesis of *E. Johnstoni*. Two photographs of the same cell, focused on different planes, are superimposed. The nucleolus has disappeared. × 1000.

(*c*) and (*d*) Two photographs of the same cell in early diakinesis (*E. globulus*). The nucleolus is seen in (*d*) in close conjunction with a chromosome (*n*). The chromosome marked by the arrow appears in both photographs. × 1000.

Figs. 1 *a* and *b* show a typical metaphase I, and a composite photograph of diakinesis in *E. Johnstoni*; figs. 1 *c* and *d* are two photographs focused on different planes in a nucleus in diakinesis in *E. globulus*.

Our best thanks are due to the trustees of the Science and Industry Endowment Fund for a grant, without which this work would not have been possible.

A. L. MCAULAY.
F. D. CRUICKSHANK.
R. G. BRETT.

University of Tasmania.
July 10.

## Carbohydrate Metabolism

EXPERIMENTS which have been in progress in this laboratory during the past six months have had results very similar to those described by Krebs[1] in a recent letter. The formation of α-ketoglutaric acid in the course of pyruvic acid oxidation was made very probable by my earlier results[2]. In recent experiments the formation of succinic acid from pyruvic acid, acetic acid and α-ketoglutaric acid could be demonstrated both anærobically in minced brain and ærobically in the minced brain poisoned with malonic acid. Two explanations of these facts are possible: (1) there are two alternative paths of succinic acid formation from pyruvic acid, one leading to α-ketoglutaric acid by the condensation of two molecules of pyruvic acid and subsequent decarboxylation[2], the other starting with decarboxylation of pyruvic acid to acetic acid and subsequent condensation of two molecules of acetic acid[3]; (2) α-ketoglutaric acid is formed by condensation of one molecule of pyruvic acid and one molecule of acetic acid. It has not yet been possible to decide which is correct.

The decarboxylation of α-ketoglutaric acid by brain slices under anærobic conditions depends on the presence of suitable hydrogen acceptors. The carbon dioxide evolution is increased on addition of a neutralized dye (Brillant cresyl blue) and reduced to the initial value as soon as the dye is decolorized (Fig. 1). The carbon dioxide evolution due to the reduction of the dye[4] is very small in the case of Brillant cresyl blue and can easily be allowed for. The amount of carbon dioxide given off by decarboxylation of α-ketoglutaric acid is almost exactly equivalent to half the amount of the added dye. Since two molecules of dye correspond to one molecule of oxygen, the *R.Q.* under these conditions is 1, the same as in ærobic experiments. Since the amount of hydrogen acceptor is the limiting factor of the

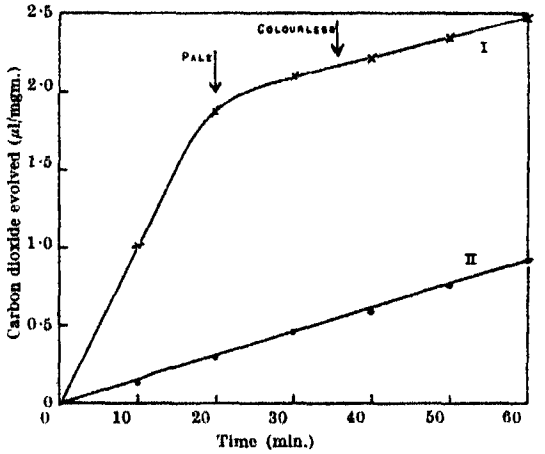



FIG. 1. Carbon dioxide evolution by slices of guinea pig brain in nitrogen in presence of *m*/50 α-ketoglutaric acid; I, after addition of Brillant cresyl blue (0·15 ml. of *m*/50 sol.; carbon dioxide corrected for the amount due to reduction of the dye); II, without Brillant cresyl blue.

decarboxylation, it is concluded that a dehydrogenation precedes the decarboxylation, thus excluding the possibility of an aldehyde as intermediate. In analogy to the oxidative deamination, the following mechanism of decarboxylation may be suggested:

$$\underset{\text{Enolic form of keto acid}}{R - CH = \overset{\displaystyle OH}{\overset{|}{C}} - \overset{\displaystyle HO}{\overset{|}{C}} = O} \xrightarrow{-H_2} \underset{\text{Ketene}}{R - CH = \overset{\displaystyle O}{\overset{\|}{C}}} + \underset{+\,CO_2}{\overset{\displaystyle O}{\overset{\|}{C}} = O}$$

$$\xrightarrow{+H_2O} \underset{\text{Carboxylic acid}}{R - CH_2 - C\begin{matrix} \diagup OH \\ \diagdown\!\!\searrow O \end{matrix}} + CO_2.$$

Glucose, which provides suitable hydrogen acceptors, can replace the dye, as shown by anærobic succinic acid formation from α-ketoglutaric acid. Pyruvic acid liberates carbon dioxide and forms succinic acid anærobically even in absence of glucose or other hydrogen acceptors, no doubt because it acts itself as hydrogen acceptor, being partly reduced to lactic acid. The system β-hydroxybutyric acid ⇌ acetoacetic acid, quoted by Krebs, is only one of many reversible oxidation-reduction systems in the cell, which act as reserve hydrogen acceptors guaranteeing the progress of vital oxidations independently of the varying oxygen supply.

H. WEIL-MALHERBE.

Cancer Research Laboratory,
Royal Victoria Infirmary,
Newcastle-on-Tyne.
Sept. 2.

[1] Krebs, NATURE, 138, 288 (1936).
[2] Weil-Malherbe, *Biochem. J.*, 30, 665 (1936).
[3] Thunberg, *Skand. Arch. Physiol.*, 40, 1 (1920).
[4] Reid, *Biochem. Z.*, 242, 159 (1931).

KREBS[1] stated recently that vitamin $B_1$ is a co-enzyme for two anærobic reactions, of which one is the following:

$$\alpha\text{-ketoglutaric acid} + \text{'ketonic' acid } (A) + H_2O \rightarrow \text{succinic acid} + CO_2 + \text{'hydroxy' acid} \ldots (3)$$

where the reaction is common to carbohydrate metabolizing animal tissues, and where $A$ can be pyruvic acid; the ærobic oxidation of pyruvic acid is considered to be preceded by an anærobic stage.

These conclusions would not seem to be general for the following reasons. We happen to have tested Krebs's reaction 3 already among others, using avitaminous pigeon's brain tissue in presence and absence of vitamin $B_1$. Our tests were ærobic, but they cover the point because any succinic acid formed should be detectable by an increased oxygen uptake in the presence of the abundant succinoxidase present. No increased (or decreased) vitamin $B_1$ effect was observed by adding α-ketoglutaric to pyruvic acid. Hence in our brain systems, the extra oxygen uptake catalyzed by vitamin $B_1$ in presence of pyruvic acid does not follow the lines of the above equation.

We are not yet in a position to make a statement about Krebs's reaction (1) as regards our system; but we can say that we have definite evidence against the view that the oxidation of pyruvic acid proceeds through the stage of succinic acid, which has been suggested for muscle[2] and for kidney[3].

G. K. MCGOWAN.
RUDOLPH A. PETERS.

Department of Biochemistry,
Oxford.
Sept. 7.

[1] Krebs, NATURE, 138, 288 (1936).
[2] Toenissen and Brinkman, Z. physiol. Chem., 187, 137 (1930).
[3] Elliott and Schroeder, Biochem J., 28, 1930 (1934).

## Points from Foregoing Letters

THE content of oxygen by volume at high altitudes, obtained by means of registering balloons with a new device for air sampling, is found by Prof. E. Regener to decrease from 20·9 per cent at 14 km. to 20·4 per cent at 28 km. At heights above 20 km. there are relatively great variations in composition, due probably to weather conditions.

No increase in the normal amount of cosmic rays that could be attributed to the appearance of Nova Lacertæ was observed by Drs. J. Barnóthy and M. Forró between June 19 and July 17 on pointing their 'counters' towards the new star at its highest position in the sky.

The ionization current due to slow neutrons produced in a boron-coated chamber has been measured by J. Rotblat in absence and in presence of absorbers of cadmium, silver, gold and iodine. The diminution of the ionization current for each element is proportional to the number of neutrons selectively absorbed in this element, and to their coefficient of absorption in boron. Assuming that this coefficient is inversely proportional to the velocity of neutrons, and that the 'cadmium' neutrons possess thermal energies, that is 0·025 e.v., Mr. Rotblat finds that the 'silver' neutrons have an energy of about 3 e.v., the 'gold' neutrons about 4·5 e.v., and that the energy of 'iodine' neutrons is essentially higher.

By plotting the strength of the current induced in a supraconducting ring of tin against the field intensity, L. Shubnikov deduces, as a necessary condition of supraconductivity, that the magnetic field should be zero in the whole of the volume and its effective tangential component should not exceed a critical value at any point of the surface of the supraconductor.

Small quantities of nitric oxide reduce the rate of thermal decomposition of dimethyl ether, but larger quantities increase it. P. F. Gay and Prof. M. W. Travers find that the end products in the two cases are different, and they consider that the effect observed with nitric oxide cannot be attributed to catalysis. They postulate the formation of short-lived intermediates.

Mandelic acid loses its optical activity (becomes 'racemized') when heated at 140° in heavy water. Prof. H. Erlenmeyer, H. Schenkel and A. Epprecht find that the number of heavy hydrogen atoms which replace ordinary hydrogens in the mandelic acid molecule during this transformation supports the Werner-Hund conception of the mechanism of racemization. They also report the influence of the heavy hydrogen on the optical activity of the mandelic acid.

The properties and reactions of two sulphur-containing camphor derivatives (*l*- and *dl*-*bis*-thiocamphor), synthesized by D. C. Sen, are reported by Sir P. C. Rây.

An example of the effects of slow erosive shift of surface soil material on the zoning of soil types around high points in a region of peneplain topography is adduced by G. Milne from the central plateau of Tanganyika Territory. Comment is made on the use to which the word *profile* has been put in soil terminology.

Dr. M. Schlesinger describes the use of hollow cylinders coated with a thin gel layer, and rotating with the axis vertical, for the study of systems of high dispersity. The distance which the particles have to travel being reduced to a few tenths of a millimetre, the effect of a given centrifugal force is increased many hundredfold if compared with usual conditions. The use of the gel provides satisfactory separation of 'supernatant' and 'sediment', and the possibility of estimating sedimentation rates and equilibria on substances not subject to direct optical observation. The method is proving particularly useful for the study of biological agents (viruses, bacteriophages, antibodies).

Photomicrographs of pollen mother cells of *Eucalyptus Johnstoni* and *E. globulus* are submitted by Prof. A. L. McAulay, F. D. Cruickshank and R. G. Brett; they show that the haploid number of chromosomes for both those species is eleven.

Dr. H. Weil-Malherbe reports the formation of succinic acid from pyruvic, acetic and α-ketoglutaric acids by brain tissue, both under anærobic and ærobic conditions. It is claimed that decarboxylation is an oxidative process, with ketene as possible intermediate. The reversible oxidation-reduction systems in these reactions are held to function as reserve hydrogen acceptors, which may replace oxygen.

# Research Items

## Population of the Northern Plains Indians

DR. CLARK WISSLER has made a study of the size of certain American Plains Indians tribes during the period of the fur trade and under the reservation system (*Yale Univ. Publications in Anthropology*, No. 1). He reviews the available data in time sequence, dealing with the Blackfoot group, the Assiniboin, and the Western Cree, who became Plains Indians before the close of the fur trade period, and then wandered about, like the Assiniboin, in bands. The fur trade period is taken as extending from 1670 to 1870. Certain general conclusions emerge. There were repeated expansions into the area of the Northern Plains, largely by Algonkin speaking tribes, such as the Blackfeet, Arapaho, Gros Ventres, etc. These expansions seem to have had a common source. The Blackfeet, apparently, were the first. The Gros Ventre held most of the Saskatchewan area in 1754, but then began to retract, when the Assiniboin were expanding into the area. These reached their maximum in 1830. The great expansion of the Cree began about 1800 and culminated in 1875. The study of population suggests that these expansions were accompanied by an increase in population; and when the tribes retracted, population shrank. The expansions from the Lake country were not all in historic times and not all due to white pressure. The coming of the horse, firearms and the expansion of the fur trade were stimuli. Diminishing returns in buffalo and fur began about 1850. The disappearance of the buffalo and the taking up of reservation life were severe blows to numbers and culture. However, recovery set in at an early date, and a few tribes seem to have suffered little population loss. The reservation system may be considered a stabilizer, and saved many tribes from destruction. Instead of proving a quick method of absorbing the Indian, as was anticipated, it has proved the reverse. At present the national Indian policy is to conserve tribal culture rather than to destroy it.

## Fossil Men of Engis

A RE-EXAMINATION by Dr. Charles Fraipont of the evidence relating to the discovery by Philippe Charles Schmerling in 1830 of two human skulls associated with a fossil fauna and flint implements in caves at Engis, near Liège, has established the fact that Schmerling was the first to discover an example of Neanderthal man (*Archives de l'Inst. Pal. Humaine, Mém.*, 16). The first skull, the only one described hitherto, is well known as a member of the Cro-Magnon race, but of a less specialized type, belonging to the group Brnö, Vistonič and Combe-Capelle. The second, however, never previously described, is now shown to be the skull of a Neanderthal child. The association of the two different types in a single stratum is explained as due to an Aurignacian burial. The stratigraphy of the cave shows no trace of occupation after Aurignacian. The industry is Aurignacian overlying Mousterian. Associated with the Aurignacian implements were the bones, intentionally broken, of *Equus*, *Bos* and *Rangifer*, while in the stratum below, where an Aurignacian industry overlies Mousterian, the human remains were associated with *Elephas primigenius*, *Rhinoceros tichorhinus*, *Hyaena spelaea*, *Ursus spelaeus*, etc., belonging to Middle or Upper Quaternary. The age of the Neanderthal child of Engis, as indicated by the dentition, is probably less than seven years. None of the milk teeth had fallen. The molars had not yet erupted. The median permanent incisors are enormous and their pulp cavity much larger than in *Homo sapiens*. The enamel of the molars shows the characteristic creases found in the child's skull of Gibraltar and of La Quina, as well as in the anthropoids and *Sinanthropus*. The Engis child shows an acceleration in the development of the cranial skeleton, which is still sometimes found in the inferior races, and is characteristic of the great apes; and it also shows the characteristic position of the foramen in which Neanderthal man approaches the apes. The temporal bone, and in particular the tympanum, shows primitive characters which disappear in the adult, but are found in the human fœtus, in *Sinanthropus* and to some degree in certain species of apes.

## Archæological Excavations in Moravia

SOME further important archæological discoveries have just been made, according to an announcement in the Central European Press, at Věstonice in the valley of the Dyje, Moravia, near the place where the 20,000 years old 'Věstonice Venus' was unearthed some six years ago. Large numbers of stone and bone implements, some of them of a unique type, have been unearthed. One of the objects is a spear, thirteen inches long, carved out of a horn from a diluvial stag in excellent condition, and, like the five-inch female figure of the Moravian mammoth hunters, testifies to the skill of the artists of that period. Handsome pendants and carved ornaments of mammoth bone, crystal spheres and implements chipped out of quartz, and a stone borer unique for the Moravian diluvium are among other interesting finds.

## Swallows in Britain

FOR two years an inquiry covering many aspects of the life of the swallow has been conducted in Britain under the auspices of the British Trust for Ornithology. The results of the 1935 inquiry are summarized in *British Birds* (30, 98, Sept. 1936) by A. W. Boyd. It would appear that swallows in the Lowlands of Scotland and north England lay larger clutches and rear larger broods than birds breeding in the southern part of England, and the suggestion is made that the fact may be associated with longer hours of daylight in northern latitudes. But we surmise that amount of food must be involved, and that no increase of daylight in the absence of increase of food would affect the clutches. How many eggs do swallows lay in the extreme north of their breeding range? Heavier rainfall cannot be shown to have any adverse effect upon size of clutches. The average brood for the whole country is just over four; the normal clutch is five, but six eggs, usually found in the northern counties, are not infrequent. The density of swallows varies enormously, from 40 pairs to 1,000 acres in well-populated rural districts of Norfolk and Anglesey where nesting-sites are

common; to between 20 and 33 pairs in the cattle-raising districts of western England and Wales; and low numbers, 2 to 6 pairs, in industrial areas, in a large area of the Lake District, and on the downs of Sussex and moors of Suffolk.

### The Migrations of Birds

A VALUABLE summary of the voluminous and scattered literature upon the migratory movements of birds in 1926–35 is given by Dr. A. Landsborough Thomson in the *Ibis* (p. 472, July 1936). The report classifies and groups the findings of field observations and experiments, and shows in what respects old theories must be modified to meet new knowledge. The portion which ought to make the greatest appeal to ornithologists in general is that dealing with recent experiments devised to elucidate the fundamental problems of migration, its purposes and origin, the stimuli which set migrants on their journeys, and the forces which guide them; for experimental evidence has greatly narrowed down some of these problems in recent years.

### American Land and Freshwater Isopods

A MOST useful monograph recently published is Willard G. Van Name's "The American Land and Fresh-Water Isopod Crustacea" (*Bull. Amer. Mus. Nat. Hist.*, 71; 1936). The author gives a description and figure, or figures, of all species known from North and South America and the neighbouring islands, and also describes many new species. The introductory remarks on the general characters and relationships of the group are clear and simply written, enabling a beginner to benefit by them, and yet the whole is a handbook for any specialist to use. There are 254 land isopods, very nearly 75 per cent of which are found in that part of America which lies within or close to the tropics, including the West Indies as well as the continental areas, and there are 49 freshwater species, 17 being tropical. There are no freshwater isopods known from Bermuda, Galapagos and Juan Fernandez Islands, and the few land forms are largely species from the Old World and littoral forms, a few species being peculiar to the islands. It is satisfactory that the genus *Ligia* is used here instead of *Ligydia*, and we heartily agree that to upset and abandon so well established a genus as *Ligia* Fabricius on such insufficient grounds is unjustifiable.

### Fasciation in Plants

A COMMUNICATION has been received from Mr. C. J. Bond, of Fernshaw, Springfield Road, Leicester, which raises the question as to whether the hæmagglutinating substance present in the watery extract of the seeds of the runner bean, *Phaseolus multiflorus*, but absent from the seeds of the broad bean, *Vicia Faba*, may have any connexion with a fasciation he has observed to occur when the axillary shoots grow out, after the amputation of plumule and cotyledon, in the runner bean but not in the broad bean. Mr. Bond finds that the hæmagglutinating substance is present in the cotyledons of the seed of the runner bean but not in the cotyledons of the seedling, which are 'exhausted' by the demands of the growing seedling. It remains for further work, however, to show whether this substance is causally connected with the fasciation of the axillary shoots forced into vigorous growth after amputation of the plumule and one or both cotyledons.

### Mosses of Fiji

THE strategic position of the Fiji Islands in connexion with the geographical distribution of flowering plants applies equally to the mosses. A strong thrust of typical south-eastern Malaysian species indicates a migratory current through the region. Mr. Edwin B. Bartram has recently dealt with two hundred numbers collected by Dr. A. C. Smith in 1933–34 on outlying islands, previously unvisited by a botanist, and difficult of access, and with a few small specimens separated from J. W. Gillespie's plants in the Herbarium of Bernice P. Bishop Museum ("Contribution to the Mosses of Fiji", by Edwin B. Bartram: *Bernice P. Bishop Museum Occasional Papers*, 11, No. 20, March 20, 1936). Additional records of nineteen established species and twelve new species increase the total of known mosses from Fiji to approximately two hundred and thirty-five.

### Ecology of Alkaline Lakes of the Rift Valley

IN the final report on the work of the Percy Sladen Expedition to some of the Rift Valley Lakes in Kenya in 1929, Penelope M. Jenkin deals with the general ecology of the alkaline lakes in particular (*Ann. Mag. Nat. Hist.*, S. 10, 18, 133, July and Aug. 1936). The number of species in the alkaline lakes is small: 17 species of algæ, 11 of invertebrates, no fish or amphibia, but a large number of flamingos which come to feed upon the blue-green algæ. The paucity of the inhabitants is the more remarkable because in a neighbouring fresh-water lake, Naivasha, there were 89 species of algæ and 70 of invertebrates. The peculiar conditions of the alkaline environment apparently make for variation, since ten of the seventeen species of algæ and nine of the invertebrates were new to science. A characteristic feature of the alkaline lakes is a 'water-bloom' due to the seasonal rapid multiplication of the blue-green alga, *Arthrospira platensis*.

### Paulin Aneroids

AN account of the aneroids constructed on the Paulin System appeared in NATURE of February 23, 1929 (p. 298). Since that time the instruments have been improved and their use has been extended. Their manufacture is now in the hands of a well-known Swedish firm, Telephonaktiebolaget L. M. Ericsson, of Stockholm, and their distribution in the United Kingdom is in the hands of C. E. Johansson, Ltd., 12 Queen's Road, Coventry. The null reading principle is retained. The total range of movement of the diaphragm of these aneroids is still restricted by stops to a maximum of 1/40 mm. The diaphragm is kept expanded by a spiral spring the tension of which is altered by a micrometer screw. The spring is set until the diaphragm is in a certain normal position which can be observed on a small scale marked with a zero line, and the movements of a pointer attached to the micrometer screw are read on a large circular scale graduated to give the atmospheric pressure, the variations of which are compensated for by the variations of the tension of the spiral spring effected by hand. It is claimed that the errors of hysteresis, which constitute the worst defect of the ordinary aneroid, are practically eliminated by this null method, and that great sensitivity is attained without the production of frictional errors of the size of those introduced when the movements of a diaphragm are greatly magnified by a system of levers. The

latest catalogue does not say how the problem of correcting this mechanism for changes of temperature has been solved, but states that such errors have been greatly reduced, and that the temperature coefficient is not only very low but also much more constant over the ordinary range of temperature than in the ordinary type of aneroid.

### Cloud Chamber Observations of Cosmic Rays

C. D. ANDERSON and S. H. Neddermeyer (*Phys. Rev.*, 50, 263; 1936) have taken a large number of Wilson cloud chamber photographs of cosmic ray phenomena on Pike's Peak at an elevation of 4,300 metres. The chamber was set off automatically by the cosmic rays through the usual coincidence counter control, and a magnetic field of 8,000 gauss was maintained by a solenoid. The tracks obtained are similar to those at ground level, but 'showers' are more frequent in relation to the general cosmic radiation. It seems furthermore that showers containing a large number of tracks increase more rapidly with altitude than smaller showers. Some measurements of the energy loss of fast particles going through lead plates in the chamber were made. A certain number of strongly ionized tracks were found, corresponding probably to 'heavy' particles and most probably to protons. They appear to be ejected in all directions, and to be secondary rays produced by nuclear disintegrations. The high energies of these particles show that they must be produced by the cosmic rays. A search at sea-level for protons made with a special ionization chamber by C. G. and D. D. Montgomery, W. E. Ramsey and W. F. G. Swann (*Phys. Rev.*, 50, 403) showed that these did not exceed 5 per cent of the total rays.

### Separation of Gaseous Isotopes by Diffusion

THE automatic multiple diffusion apparatus invented some years ago by G. Hertz has been studied in considerable detail by D. E. Wooldridge and W. R. Smythe (*Phys. Rev.*, 50, 233; 1936). It consists of porous diffusion tubes with diffusion pumps arranged to collect the gas as it diffuses through and to return it to the appropriate part of the fractionation system. In order to examine the behaviour of the apparatus, it was used to separate mixtures of nitrogen and carbon dioxide. The separation obtained with an apparatus of twenty-four elements agreed well with theory. An apparatus with thirty-four elements was used to concentrate $^{13}C$ in methane and $^{15}N$ in nitrogen gas.

### A Middle-Babylonian Chemical Text

C. J. GADD and R. Campbell Thompson (*Iraq*, 2 (1), 87; 1936) describe a cuneiform tablet from Tall 'Umar (Seleucia) of the reign of Gulkishar, not later than the seventeenth century B.C., written in an intentionally obscure way by a supposed member of a guild of glassmakers. This is much earlier than the well-known Assyrian chemical texts from Nineveh (seventh century B.C.), and contains the oldest known record of actual formulæ for making glazes. The cuneiform text, its transliteration, and an attempted translation are given. Two glazes, called "lead copper" and "Assyrian copper", are composed of specified amounts of *zukû*-glass, lead, copper, lime and *mil'u* (translated 'saltpetre'). The clay for the body of a pot is then steeped for three days in a mixture of vinegar and copper, which gives a 'bloom' (verdigris). The pot is fired, and then a melted mixture of the two glazes, together with some of a similar composition, is made. A sacrifice to the "incomplete dead" (perhaps the embryo) is made, the glaze is applied and the pot is fired twice, with an addition to the glaze of a composition as before but without lime.

### Modern Treatment of Burns

IN the first-aid treatment of severe burns and scalds time is an essential factor, and the treatment applied in the early stages determines to a large extent the subsequent course of healing and recovery. The former almost universal first-aid treatment by the application of 'carron oil' seems likely to be superseded by the use of tannic acid. This agent, in the form of a 2·5–5 per cent solution, sprayed over the burnt area hourly for 8–12 hours, forms with the exudate a protective coagulum, allaying pain and preventing subsequent sepsis, which is so troublesome and dangerous. Various preparations of tannic acid have been compounded for immediate first-aid treatment, such as the "Tanna-Flavine Jelly" prepared by British Drug Houses, Ltd., Gresham Street, London, N.1. This is a non-oily preparation of tannic acid with the antiseptic dye 'acriflavine', which is put up ready for use in collapsible metal tubes suitable to form part of the equipment of first-aid outfits in works, schools and other institutions.

### Electrically Driven Steering Gear

A PAPER read to the Institute of Marine Engineers by H. G. Leivesley on marine electrical installations in service is reprinted in the *Metropolitan Vickers Gazette* for August. Steam steering gear has the advantage of low initial cost over steering gear electrically driven. The steam consumption is high and is constantly taking place even when the helm is at zero. This is due to lag in the transmission scheme and to the failure of the valves to close fully. The lack of synchronism between the helm position and the steering engine and consequently the actual position of the rudder is improved by the provision of a rudder indicator. This device operated from the rudder post gives a reading on a large-scale instrument in the wheelhouse. This affords the helmsman a definite indication of the rudder's position. As rudder angle means steam consumption, this affords some means of correction, and the consumption of the steering engine can be reduced. In long steam lines the losses due to condensation still continue. Water rates taken on a general cargo ship of 3,000 h.p. showed that the steering engine was responsible for seven per cent of the total fuel consumption. In motor ships and passenger liners, steering gear of the electro-hydraulic type is now standard practice because of the overall economy and convenience. In large ships the steering equipment is run continuously in one direction and at almost the same speed throughout the load range. In this case the motor is not subjected to any heavy stresses consequent upon starting, putting on a sudden load or reversal. For cross-channel steamers the horse power of the steering gear is 10, for a cargo ship 15 and for a liner 40. Curves obtained by tests show the ability of the modern steering motor to deal with sudden and heavy overloads when putting the helm hard over from varying degrees of rudder angle under full power steaming conditions.

# Science and the Glasshouse Industry

IN connexion with the Blackpool meeting of the British Association, Dr. W. F. Bewley delivered a public lecture on "Science and the Glasshouse Industry" at Blackpool South on September 11. Dr. Bewley prefaced his remarks by directing attention to the importance of protected crops in any scheme of food production which might become necessary if Great Britain should ever be faced with another war, and argued that new land should be broken with the plough and brought into the high state of fertility which is essential for the successful cultivation of vegetables. He also stressed the value of such crops in the diet of the people.

To form an accurate opinion of the way in which science has helped the glasshouse industry to overcome the pests and diseases which once threatened its very existence, and the way in which it has directed progress, it is necessary to consider the position prior to 1914, when organized research became possible through the establishment of the Cheshunt Research Station.

Dr. Bewley described the serious damage once caused by the tomato moth caterpillar *Polia oleracea* (£40,000 per annum in the Lea Valley alone), the white fly, *Trialeurodes vaporariorum* (£25,000 per annum), and the red spider mite, *Tetranychus telarius*. These pests were quickly controlled by measures devised at Cheshunt, and special note must be made of the importance of the chalcid parasite, *Encarsia formosa*, in controlling the white fly. Diseases such as 'damping off' and 'foot rot' caused by *Phytophthora* spp., which destroyed thousands of plants in glasshouses, *Verticillium* wilt of the tomato (*Verticillium albo-atrum*), tomato leaf mould (*Cladosporium fulvum*) and many other diseases of glasshouse plants, which once extracted an enormous annual toll, were also brought under control.

Dr. Bewley directed attention to the importance of using a clean water supply in connexion with glasshouse plants and described the work done at Cheshunt on this problem.

The 'damping off' work was the means of discovering a soil drench (Cheshunt compound) which has since been applied on a large scale for the purpose of destroying certain fungi in the soil without injuring the growing plant. A large amount of work has also been done in connexion with virus diseases, which have attracted much attention during the past ten years. Virus diseases of the tomato were described in detail, and methods for identification, prevention and control were discussed. The importance of using virus-free seeds was emphasized. It was stated that scientific research has been pursued so effectively that it is now possible to control most of the serious pests and diseases of glasshouse plants.

Passing to the question of fungicides and insecticides, Dr. Bewley paid tribute to the work of many investigators in research institutes, universities and chemical firms, whose labours have provided the vegetable growers with new sprays of greater effectiveness. He mentioned the importance of the new sulphonated oil wetting agents and the work which is being done with regard to the use of insecticidal and fungicidal compounds carried in emulsified oils.

Soil sterilization has played an important part in glasshouse work, and the processes of chemical and heat sterilization were described. Sterilization by heat is the most effective and widely used, because it destroys a wide range of organisms, whereas chemical compounds are specific in action and it is difficult to obtain satisfactory penetration of the soil in practice. The latest method of steam sterilization, by means of the 'Hoddesdon' pipe system, was described.

Work at Cheshunt has included the breeding and selection of better varieties of tomatoes and lettuce, and of tomatoes resistant to *Cladosporium fulvum*. The tomato variety E.S.1 was distributed ten years ago and is widely used, for it yields a heavy crop of good quality fruit. The work on resistant varieties has been in progress for nine years, and it now seems that the goal is in sight, for good types have been grown this year which possess a high degree of resistance to leaf mould.

The lettuce Cheshunt Early Giant is one of the triumphs of the Station. It fills a long-felt want, for it can be grown in heated glasshouses from September until March and produces large well-hearted lettuce, even at Christmas. It has provided the English growers with a splendid opportunity for beating their foreign competitors, by providing fresh well-hearted lettuce during the autumn and winter.

In glasshouse work the physical condition of the soil is of great importance. Clean straw placed in the soil with the haulms vertical has proved beneficial, as has also the use of peat either mixed with the top soil or applied as a rooting medium to the surface of the soil during the summer.

Dr. Bewley also discussed the latest methods for warming the soil by circulating hot water in pipes buried two feet below the surface. This is a new development which will no doubt become general practice in the future. Soil warming increases the rate of root production, provides large clean root systems and heavy crops. It also increases the weight of crop picked during the first few months.

The workers at Cheshunt have also investigated the use of artificial light during the propagation stages. Useful results have been obtained with cucumbers but not with tomatoes. This application of light is being held up because a suitable source of light has yet to be found. This is a task for the engineers. Engineering science has helped the glasshouse industry in the question of heating, and Dr. Bewley discussed the use of oil firing, automatic underfed stokers, gravity boilers and the steam-cum-water system.

Great importance is placed at Cheshunt upon the question of quality in vegetables of all kinds, and recently the question of tomato marketing packages was investigated. It was found that high temperatures cause the fruit to be disfigured by a yellow mottle known as 'high temperature mottle' and that bad ventilation causes softness. A new wooden box and perforated lining paper have been devised which allows the fruit to be adequately ventilated and kept in a cooler condition. It has been tested thoroughly during the past season and has given excellent results.

# Chemistry and the Community

PROF. J. C. PHILIP'S presidential address to Section B (Chemistry) of the British Association delivered on September 10, on the function and training of the chemist in the service of the community, was of much more general interest than many recent addresses or discussions in this Section but was ill-rewarded by a rather smaller attendance than is usual at the presidential address to the Section. While this may be due in part to the counter-attraction of several other discussions of wide appeal taking place at the same time, the attendance at least suggests that chemists are a long way from being alive to the social implications of their work. Prof. Philip's address, however, received the strong support of the Section, and apart from its endorsement by subsequent speeches, the approval which met many of his pertinent remarks, such as those concerning the abuse of chemistry for destructive purposes and his criticism of premature specialization and the absurdity of a university department of chemistry finding it necessary to teach its students German, was plainly manifest. Sir Josiah Stamp, who was present, spoke briefly but emphatically in agreement with Prof. Philip's views.

Mr. M. P. Applebey, who followed, discussed the particular relations between industry and the profession of chemistry. In dealing with the scope of the chemist in industry, he quoted from the joint Report of the Chemical Societies of the North East Coast to the District Commissioner for the Special Areas, which forms such an admirable example of the way in which the profession can assist in handling social problems. Despite the wide scope of the chemist's work in industry his importance is not fully realized in some industries, and industry in Great Britain does not employ its due proportion of trained chemists. The chemist is most widely recognized as an analyst, but even for this purpose men of meagre qualifications are often employed, while some firms seem to consider that analytical work exhausts the possibilities of trained assistance from the chemist. As a plant manager, he has equally important functions, and chemical processes in operation require study by controllers who understand their scientific basis if efficiency and progress are to be secured. With the wider recognition of the value of technical knowledge in sales service, the chemist is finding another outlet for his services. Mr. Applebey also commented on the purchase of processes from abroad by firms in Great Britain, and pointed out that such a policy can never be a substitute for a research policy. In the absence of a research department, considerable sums may be spent on processes which prove to be impracticable, and even perfectly good processes may require much research to adapt them to the particular conditions or to acquire the intimate knowledge of their chemistry essential for successful operation.

Mr. Applebey went beyond Prof. Philip in his remarks about the place of the chemist in management, strongly maintaining that an education in chemistry or any of the exact sciences affords as good a mental training for management as some longer established courses of education. Turning to the relations between industry and chemical education, he urged that industry first requires strong and active schools of research engaged in the pursuit of knowledge and the discovery of principles from which applications may flow. Industry also looks to the schools of chemistry for a supply of suitably trained chemists to fill such posts as have been indicated. For this purpose a good honours degree is desirable, but the honours course in chemistry should be soundly based on fundamentals, giving a firm grasp of principles. Preferably the recruit should have had two or three years of advanced experimental work, usually research, designed to develop perseverance and resource as well as technique. An industrial basis in such research is neither necessary nor desirable. Industry's obligations to chemical education are best discharged by the subsidizing of research through research scholarships, by grants for special apparatus and chemicals and the support of fundamental work and of chemical publications, both directly and through encouraging its technical staff to become members of one or more societies and participate in their work.

Mr. C. J. T. Cronshaw prefaced his paper on "the Benign Gifts of Organic Chemistry" with an endorsement of Prof. Philip's remarks regarding the need for a broad scientific basis of training. The better chemists entering the organic chemical industry are acquainted with neighbouring and borderland sciences, the better fitted they are for their job. The chemist should understand the uses to which his products are put and be able to measure and assess such properties so as to be able to improve them. Early specialization is a danger; the study of science alone is liable to produce men lacking in general culture, with little literary ability and incapable of expressing themselves clearly. General culture, he suggested, may be improved by a study of history from the angle of the rise of industries in modern times under the influence of scientific developments. Finally, Mr. Cronshaw urged that the industrial recruit should cultivate the power of criticism and of co-operating with others in a team.

Mr. Cronshaw then gave a brilliant review of the development of industrial organic chemistry, commencing with the development of the dyestuffs industry and describing the myriad contributions of organic chemistry to our comfort and well-being to-day. The quest for colour, which in itself ministers to the need of many industries, has led the industrial organic chemist into many other fields, such as those of medicine in the provision of anæsthetics, and of remedies for sleeping sickness. As with dyestuffs, the tendency with progress is to advance from the general to the specific. The motor-car industry owes much to the organic chemist alike in the improvement of tyres, oil, petrol and the finishes used for it. Organic chemistry has given the textile industry two new fibres, and in its recent work on detergents and products for the control of pests and in the field of vitamins it is continuing to confer benefits on mankind.

Sir Henry Dale, in discussing the training of chemists for work in the fields of biochemistry and medicine, referred to the way in which chemistry in recent years has invaded the fields of functional biology and the sciences related to medicine. Even in the complex field of immunity, in recent years we

have seen the beginning of exact description in terms of organic and physical chemistry. In the last few years a whole series of hormones has been isolated chemically and several synthesized. Four or five vitamins have been identified chemically and at least three synthesized. Sex hormones, one vitamin, carcinogenic substances and heart tonics have been chemically related to the typically inert sterols. Already new substances have been synthesized which promise to give control over some of the most deadly infections of man, especially in the tropics. The whole orientation of therapeutics is being shifted from the effects to the causes of disease. Sir Henry Dale suggested that the greatest service of chemistry to the community lies in this new and increasing domination of biological and medical research by chemical methods and ideas. In urging the necessity for co-operation between the chemist and those trained primarily in biology and the medical sciences, he protested strongly against the neglect in Great Britain of the study of tropical diseases. While we control more of the tropics than any other country in the world, we have done comparatively little in attacking the problems of tropical disease. It is unlikely that we shall be able to justify permanently the possession of large sections of the globe, and depend on the efforts of other nations to make them habitable.

## The Mediterranean Littoral

THE Consiglio Nazionale delle Ricerche has undertaken, through the agency of the National Committee for Geography in conjunction with the Institute of General Geography of the University of Pisa, an inquiry into recent conditions affecting sandy beaches along the Italian littoral, and in this connexion is publishing a series of monographs dealing with the coastline in ten regional sections, each of which is to form the subject of a separate volume. In this way, reviving the studies of eminent physiographers of the past, it is intended to present a chain of facts which will serve for a systematic research into the regimen of Italian beaches and so foster the advancement of scientific geography, at the same time aiding in the development of maritime engineering.

The opening volume of the series, forming an introduction to the whole subject, has been prepared by Signor Agatino D'Arrigo*, an engineer of acknowledged competence and merit, who has received the distinction of the award of a premium from the Royal Academy of Italy for his publications on coastline phenomena. He has produced an excellent historical review of the subject, giving an account of the earlier investigations of Italian observers from Leonardo da Vinci, Montanari, Marsili and Paleocapa to Cialdi and Cornaglia, including at the same time appropriate references to the facts recorded by writers of other nationalities. The first part of the volume is taken up with this disquisition, and is followed by certain deductions of a general order to which limitations of space do not permit reference in detail.

The second part consists of a series of comparative morpholithological studies of the regimen of various parts of the Mediterranean littoral, including the Nile Delta, the Delta of the Po and the adjacent Venetian region, the Delta of the Rhone, the Delta of the Tiber, the Bay of Taormina, the Algerian Littoral and the Argentarian Promontory, with a final chapter embodying the conclusions of the author.

The investigations are obviously spread over a wide field and while they serve as an admirable introduction to a further and more complete survey, their immediate value is perhaps best assessed, as stated by Prof. Toniolo in his preface to the volume, as a general confirmation of the hypothesis already advanced of the probable reversibility of the cycle of evolution of the Mediterranean littoral. For physiographers of other nationalities, the book contains a great deal of serviceable information, with useful references to the work of Italian investigators. The treatise, in fact, is commendably documented, and there is an excellent set of coloured charts showing coastline changes at various dates. B. C.

* Ricerche sul Regime dei Litorali nel Mediterraneo. By Agatino D'Arrigo. Pp. 172. (Rome: Stabilimento Tipografico "Aternum".) 50 lire.

## Educational Topics and Events

WILD-BARFIELD ELECTRIC FURNACES, LTD., Elecfurn Works, North Road, Holloway, London, N.7, have prepared a series of lantern slides illustrating many types of electric furnaces for heat-treatment, together with notes regarding the various slides. These form the basis of a paper on such equipment, and sets and lecture are available for societies, technical schools or other interested bodies.

FORMAL education for marriage is advocated by Paul H. Landis of the State College of Washington in an article on "Control of the Romantic Impulse through Education" published in *School and Society* of August 15. The mounting divorce rate in the United States, now higher than in any other country, is, he suggests, attributable in some measure to the frequency of romantic marriages, and of this the chief cause is the mobility characteristic of contemporary American life, especially in the West, where the divorce rate is highest. "In most fields now we believe in giving experience vicariously through books and the school curriculum, yet in the field of marriage and the family we let youth learn by experience." We need courses in high school and college in eugenics and the essentials of happy family life, to set up new barriers to the free exercise of the romantic urge.

THE Education Act 1936 throws upon local education committees a heavy addition to their responsibilities. In persistently agitating for the raising of the obligatory school age, for which the new Act provides, they have, as an editorial in their official organ, *Education*, of September 4, points out, created for themselves a vast moral obligation. The issues involved in adjudicating upon applications for exemption closely concern the well-being of the community: the health and physical condition of the child; the 'beneficial' nature of the proposed employment, including its prospective benefit; the opportunities to be afforded of free education; the time available for recreation; and the case of each individual child will call for careful consideration. The grant of an employment certificate in respect of an exempted child is clearly intended to be a deliberate judicial act, not the routine application of a rough and ready test. An incidental advantage

of this procedure will be that members of the committees will be constantly face to face with the question—what is the content of this final year of compulsory schooling and what is its probable value in any particular case? It is, the article points out, in this connexion, that loyal and willing co-operation between the Board of Education, local authorities and teachers will be specially desirable. A series of articles by Dr. Percival Sharp, secretary of the Association of Education Committees, on the problems presented by the administration of the new Act, is promised.

THE 'brain trust' in American politics is symptomatic of that pronounced swing towards the social sciences which has been one of the most noticeable features of university life in the United States in recent years. Commenting on this movement, the president of Yale University in an Alumni Day address urged the frank and definite recognition by universities of the "preponderant importance for our day and for the immediate future of the crucial problems of the industrial and economic order and of the individual human life in all its physical, social and spiritual aspects". Failing such recognition and energetic fulfilment of the universities' correlative obligations to the social order, they may have to face "the destruction of all that we and our predecessors have given our lives to create". But the 'brain trust', in so far as it involves the exploitation of university faculties by Government departments, is obviously liable to abuse, and a public protest has, according to *School and Society* of July 25, been made by Mr. Walter Lippmann and eight other prominent alumni of Harvard against the consequential neglect by professors of their academic duties. In Great Britain, on the other hand, one doubts whether Government departments make sufficient use of the brains of university staffs and advanced students. In the Ministry of Labour's report for 1935, for example, there is no evidence of contact between the Ministry and university departments concerned with cognate matters, although these doubtless study the masses of statistics provided by the Ministry.

THE president of Columbia University, New York, Dr. Nicholas Murray Butler, in his recent "Commencement Day" address on "The Decline and Fall of Morals", quoted Thomas Jefferson's prophecy that the cult of the "almighty dollar" would lead to heavier and heavier shackling of the people's freedom "till our rights shall revive or expire in a convulsion"—an alternative which is, Dr. Butler declared, the one dominant question before the world to-day. With this question is also bound up the fate of morals, for the destruction of liberty would make morals impossible. He referred to the German people's once powerful influence in the intellectual and economic life of the world, forfeited for the time being under a self-confident tyranny that boasts (Dr. Goebbels, on March 19) "we do not have to appeal to the people, we have the army, the police, the wireless, the press, the Nazi organization". He noted the utter disregard by Japan and Italy of moral obligation and their recourse to mass murder, and the strange mutation of Mussolini's principles since 1913, when he rebuked his countrymen for the "stupid orgy . . . in which the Italian press is now letting itself go with mad exaltation. Strong peoples have some sense of measure. Italy, rationalist and militarist, shows that it lacks this sense . . . a miserable war of conquest (the conquest of Tripoli) is acclaimed as if it were a Roman triumph." Another university president, Dr. Sproul of the University of California, speaking on June 30 on "America's Answer to Youth's Appeal", similarly stressed the preponderant importance for our day of safeguarding "freedom and tolerance, respect for the individual, regard for the rights of minorities. . . ."

## Science News a Century Ago

### J. D. Forbes and Auguste de la Rive

THE enthusiasm shown at the Bristol meeting of the British Association in the experiments of Andrew Crosse, referred to in NATURE last week, was not shared by J. D. Forbes, who shortly after returning from Bristol, on September 26, 1836, wrote to Auguste de la Rive: "The subject of Mr. Cross is, I confess, rather a disagreeable one to me. You will readily enough conceive how much people more conversant with geology than electricity must have been struck by hearing most eloquently expounded a series of experimental discoveries, for they were perfectly original to Mr. Cross, silently prosecuted for many years by a retired country gentleman in Somersetshire, and only elicited by chance in the course of discussion. From the first moment that the matter was mentioned to me, and on every succeeding occasion, I really believe not less than fifty times, I have patiently vindicated the claims of Becquerel, which only require to be mentioned to be acknowledged. I own I felt somewhat indignant on the subject, because having seen Becquerel's magnificent preparations and conversed at great length with him on the subject, I had been led at various times, publicly and privately, for several years, to draw the attention of geologists to one of the very best things ever done for their science. . . ."

### Medical Museum at King's College, London

ON September 30, 1836, *The Times* said: "The Society of Apothecaries has lately enriched the various collections in the medical school [of King's College] by the presentation of a large and beautiful series of specimens of the materia medica, being duplicates of those selected from their own collections at Apothecaries-hall. As much care is required in choosing the purest and best specimens, many of which it requires time to procure, it is not expected the collection will be quite complete for many months. A new room has been opened in the college for their now extensive museum of materia medica. The dormitories for the students, fully furnished, and abundantly ventilated, a new medical reading room, as well as dining-hall or refectory, to be opened early in October, are among the newest improvements in the college."

### Sturgeon's *Annals of Electricity*

IN October 1836 appeared the first number of the periodical "The Annals of Electricity, Magnetism, and Chemistry and Guardian of Experimental Science, conducted by William Sturgeon, Lecturer on Experimental Philosophy at the Honorable East India Company's Seminary, Addiscombe, etc., and assisted by gentlemen eminent in these departments of philosophy". The greater part of the number

appears to have been written by Sturgeon himself. There were articles on the galvanometer, electro-chemical action exercised by simple metals in fluids, electro-pulsation and electro-momentum, a letter from Sturgeon to Faraday and a description of an electro-magnetic engine for turning machinery.

Sturgeon was undoubtedly one of the most industrious men of science of his day. He was born in a village near Kirkby Lonsdale, Lancashire, in 1783, and at thirteen years of age he was placed under a shoemaker who starved and ill-used him; at nineteen he entered the militia, at twenty-one became a private in the Royal Artillery and at thirty-seven left the army with a pension of a shilling a day. He had meanwhile taught himself mathematics, Greek and Latin, and begun his electrical experiments. On leaving the army he set up as a bootmaker at 8 Artillery Place, Woolwich. In 1823 he began contributing to the *Philosophical Magazine*, and in the following year, mainly through Olinthus Gregory, S. H. Christie and Peter Barlow, was appointed to the lectureship at Addiscombe. He was also connected with the Adelaide Gallery of Practical Science in Adelaide Street, London, and in 1840 removed to Manchester to superintend the Royal Victoria Gallery of Practical Science, an institution which, however, had but a short life. His writings were very numerous and to him we owe the construction of the first soft-iron electro-magnet. In his later days he felt the pinch of poverty, and a year before his death in 1850, he was granted a Civil List Pension of £50 a year.

### Darwin's Reflections on Travel

On October 2, 1836, H.M.S. *Beagle* arrived at Falmouth after a voyage which had taken her round the world and had lasted nearly five years. In concluding his "Journal of Researches", Darwin gave a short retrospect of "the advantages and disadvantages, the pains and pleasures, of our circumnavigation of the world". In concluding this retrospect, he said: "it appears to me that nothing can be more improving to a young naturalist, than a journey in distant countries. It both sharpens, and partly allays that want and craving, which, as Sir J. Herschel remarks, a man experiences although every corporeal sense be fully satisfied. The excitement from the novelty of objects, and the chance of success, stimulate him to increased activity. Moreover, as a number of isolated facts soon become uninteresting, the habit of comparison leads to generalisation. On the other hand, as the traveller stays but a short time in each place, his descriptions must generally consist of mere sketches, instead of detailed observations. Hence arises, as I have found to my cost, a constant tendency to fill up the wide gaps of knowledge, by inaccurate and superficial hypotheses.

"But I have too deeply enjoyed the voyage, not to recommend any naturalist, although he must not expect to be so fortunate in his companions as I have been, to take all chances, and to start, on travels by land if possible, if otherwise on a long voyage. He may feel assured he will meet with no difficulties or dangers, excepting in rare cases, nearly so bad as he beforehand anticipates. In a moral point of view, the effect ought to be, to teach him good-humoured patience, freedom from selfishness, the habit of acting for himself, and of making the best of every occurrence. In short, he ought to partake of the characteristic qualities of most sailors. . ."

## Societies and Academies

### Paris

Academy of Sciences, August 3 (*C.R.*, 203, 353–392).

Emil J. Gumbel: The extreme periods between radioactive emissions. Comparison of theory and experiment for polonium. The good agreement between the frequencies found and the probabilities proves that the extreme periods between the radioactive emissions follow the theory of the greatest value.

S. Lechnitski: Some problems of elasticity of anisotropic bodies.

Kyrille Popoff: The solution of the differential equations of the pendular movement of a projectile.

Daniel Chalonge: A remarkable variation in the spectrum of γ-Cassiopeia. An appreciable increase in the brightness of this star was noted on the night of July 25–26 last: spectroscopic observations made on July 30–31 and August 1–2 showed a change in the spectrum mainly due to a large increase in the emission of Balmer lines.

René Rivault: Experimental researches on the propagation of short electric television waves ($\lambda = 41 \cdot 5$ metres, $\lambda' = 74$ metres).

Maurice Dodé: The thermochemistry of the nitrites of the alkalis and alkaline earths.

Basile Fedoroff: The conductivity of the double sulphates of the magnesium series in aqueous solution. Eight double sulphates have been studied. Except at very low concentrations, the double salt is always less dissociated than the simple salts.

Clément Courty: The increase of the magnetism of ferric oxide by ignition in the presence of ash-free filter paper.

Gabriel Bertrand: Observations on the preceding communication concerning the discovery of iron in plant ash.

Georges Jouravsky: The optical properties, densities and degree of corrosion of the alumino-magnesium titanomagnetites.

Henri Ringard and André Duparque: The microscopic characters of Courrières coals.

Fernand Jacquet: The middle Eocene with Nummulites of Senegal.

Yves Milon: The fossil *yardangs* of Saint-Pierre-la-Cour (Mayenne).

Conrad Kilian and Théodore Monod: The discovery in the western Sahara of fossil micro-organisms forming an indicator as regards age and marine nature of the Koundeloungou (Congo) series.

Lucien Cayeux: Remarks on the preceding note.

Jean Dufay: The Huggins bands in the spectrum of the blue sky and the temperature of atmospheric ozone.

Paul Budker: The destruction and fall of the mandibular teeth in *Squalus*.

Jean Jacques Bounhiol: Metamorphosis after ablation of the *corpora allata* in the silkworm (*Bombyx mori*).

Stig Veibel and Franciska Eriksen: The influence of aglucone on the velocity of hydrolysis of the β-glucosides by emulsine.

August 10 (*C.R.*, 203, 393–416).

Lucien Daniel: Acquired heredity in bulb producing leek.

David Belorizky: Some peculiarities of Nova Lacertæ, 1936. The radiation of this star is monochromatic and almost entirely concentrated in *Hα* radiation.

MLLE. YVETTE CAUCHOIS: Observation and measurements of the $L\alpha$ satellites for the elements 68, 70 and 71.

HORIA HULUBEI: Observation and measurement of the $L$ spectrum of radium (88) I.

JOSEPH CATHALA and JEAN CLUZEL: The spectrophotometric study of the hydrolysis of ferric salts.

ETIENNE VASSY: Spectrographic method for the study of the thermal decomposition of ozone.

LOUIS FAUCOUNAU: A new method for the preparation of catalysts. The Raney method of preparing active nickel by attacking a nickel-aluminium alloy with alkali has been extended to alloys of copper and cobalt.

HENRI COUPIN: The germination of pollen grains.

LOUIS GALLIEN and MARC DE LARAMBERGUE: Cycle and sexual dimorphism of *Lacuna pallidula*.

CHARLES DHÉRÉ and OSCAR BIERMACHER: The living geranium leaf emits a fluorescence radiation which extends in the infra-red to $\lambda$ 830 $m\mu$.

RENÉ WOLF, MAURICE RANGIER and MLLE. ANDRÉE BOURQUARD: The relations existing between the magnesium of muscle and chronaxy.

August 18 (*C.R.*, 203, 417–444).

VITO VOLTERRA: The principle of least action in biology.

HERMAN AUERBACH: The analytical representation of Lie groups.

CAÏUS JACOB: A gaseous jet.

JULIEN KRAVTCHENKO: The problems of conformal representation of Helmholtz.

GINO ARRIGHI: The movements of a deformable body associated with general electro-magnetic fields.

NY TSI-ZÉ and WENG WEN-PO: The absorption spectrum of potassium. In addition to the lines or bands already described by H. Kuhn and by Datta and Chakravarty, new lines or bands have been found, and these have been empirically classified in series.

HENRI LONGCHAMBON and GEORGES MIGEON: The sepiolites. Results of a physical and chemical examination of three specimens of sepiolite from different sources and remarkable for their purity and crystal formation. Reasons are given for not adopting the theoretical interpretation recently proposed for sepiolites by J. de Lapparent.

ROBERT LAFFITTE: The Neocomian in Aurès (Algeria).

MLLE. MARIA LEJEUNE: A means of isolating the micro-fossils included in flints. Attack by gaseous hydrofluoric acid under the conditions specified gives better results than the aqueous acid proposed by other workers in the same field.

THEODOR SOLACOLU and DEMETRE CONSTANTINESCO: The action of $\beta$-indolylacetic acid on the development of seedlings.

M. SUREAU and P. GRANDADAM: The spectrophotometric estimation of $\alpha$-œstrone and its derivatives.

## Brussels

Royal Academy (*Bull. Classe Sci.*, 22, No. 6, 1936).

L. GODEAUX: A property of Green's first straight line of a surface.

P. GÉRARD: The significance of the terminal nerve according to observations made on *Polypterus Weeksi*.

C. PATERNOSTER: The advances and retardations of the transits of Mercury across the solar disk.

M. LINSMAN: The singularities of the elementary curves in finite geometry.

F. BACKES: $R$ congruences.

T. H. J. LEPAGE: Geodesic fields of the calculus of variations.

C. PERELMAN: M. Gödel's antinomy.

J. PASTEELS: Analysis of the morphogenic movements of gastrulation in birds.

J. THOREAU: Crystalline calcic rocks of Kivu.

## Moscow

Academy of Sciences (*C.R.*, 2, No. 5, 1936).

V. S. IGNATOVSKIJ: The Laplace transformation (2).

A. MITKEVITCH: Magnetic viscosity at different points of the magnetization curve.

A. A. GRÜNBERG and J. L. MICHELS: Determination of iridium by potassium ferrocyanide titration.

P. PANJUTIN, L. HINDIN and O. VASILJEVA: An investigation of the autoxidation of carbohydrates. (1) A new method for the quantitative analysis of peroxide compounds.

A. EBERZIN and O. VJALOV: An ancient Euxinian terrace in the environs of Tuapse.

I. SMORODINCEV and K. BEBESHIN: The glycogen content of ascarids. Ascarids contains twelve times as much glycogen as the higher vertebrates, but only one tenth of their lipoids.

N. A. ŠČIBRIA: Hybrids between the Jerusalem artichoke (*Helianthus tuberosus* L.) and the sunflower (*Helianthus annuus* L.).

M. A. SIZOVA: Structural changes in chromosomes induced by irradiation of physiologically modified cells.

L. V. MICHAJLOVA: (1) Reaction of the drumhead cabbage to lowering of temperature. (2) Light regime requirements of tomatoes.

N. V. NASSONOV: Peculiarities and causes of the development of additional growths in Amphibia.

(*C.R.*, 2, No. 6, 1936).

I. NATANSON: Some remarks on the theorem of Stekloff-Severini.

G. KRUTKOW: Statically indefinite systems. The ultra-definite system.

B. FESENKOV: Absolute photometry of the solar corona. A method is discussed that makes it possible to eliminate completely the influence of the atmosphere.

N. SELJAKOV: Some remarks on $\alpha$- and $\beta$-ice.

S. RYTOV: The diffraction of light by ultrasounds.

N. DOBROTIN: Absorption of neutrons in silver and cadmium.

V. M. KATUNSKIJ: (1) Intensity of geotropic reaction as a quantitative index of the content of growth-promoting substance. Intensity of geotropic curvatures of the coleoptiles of oats and the seedlings of castor-oil plants varies directly as the quantity of growth-promoting substance. (2) Growth-promoting substance and the formative action of light on vegetation in plants.

A. I. GREČUŠNIKOV: The physiology of the incubation period in rust infections.

G. D. ADLER: New data on the geological structure of the region of the Taimyr folding.

S. S. ELIZAROVA: The influence of hydrogen ion activity and of salinity on the eggs of *Engraulis encrasicholus* L. (anchovy). The limits of toleration to the $p$H concentration and the salinity of water differ in the Black Sea and the Azov Sea races of the anchovy.

## Rome

**Royal National Academy of the Lincei**
(*Atti*, 23, 161–249; 1936).

L. TONELLI: A fundamental proposition of mathematical analysis.

G. ARMELLINI: Eccentricity of binary systems in the case of masses which vary with time.

G. GIORGI: Concerning electric and magnetic inductivities.

E. BORTOLOTTI: Non-linear relations: geometry of a system of equations with partial derivatives of the second order (3). Other intrinsic differential operators. Descriptive properties of the system.

G. SCORZA DRAGONI: Some theorems on Jordan's curves.

A. TERRACINI: Space varieties of $\infty^1$ spaces.

G. USIGLIO: New interpretation of propagation in the second medium in total reflection.

G. BERGAMI, P. BAER and E. BOERI: Variation of the excretion of allantoin by rats in relation to ketogenic and anti-ketogenic diets.

A. C. BLANC: Pleistocene beach with *Strombus bubonius* near Palidoro (Rome).

A. DESIO: New geological bases for search of phosphates in Lybia.

M. PITOTTI: Gastrulation of the egg of Lampreda (*Lampetra fluviatilis* L.). Displacement of substances during gastrulation.

M. LAPORTA and C. VACCA: Biological and chemical tests on the product of the irradiation of follicular hormone with ultra-violet rays.

A. CARTENÌ and C. VACCA: Chemical composition and energy value of diets consumed in two marine colonies.

C. GUARESCHI: Experiments with X-rays and with radium on the nymphosis of insects.

E. FAGIOLO: Researches on the pronephros in amphibia (2).

A. SPIRITO: New experiments on the influence of a continuous electric current on the meristems of roots.

A. CESARIS-DEMEL: Memorial lecture on Ettore Marchiafava.

## Vienna

**Academy of Sciences, June 25.**

HEINZ TH. GRAZIADEI: Cosmic rays and solar activity. The correlation coefficient between cosmic ray intensity and activity of solar flocculi is $-0{\cdot}48$. There is a 27-day periodicity in the cosmic ray intensity.

L. KAHOVEC and K. W. F. KOHLRAUSCH: Raman spectrum of hydrazine and its hydrate. A Raman frequency of 1620 cm.$^{-1}$ occurs in hydrazine and its hydrate if the violet light be filtered out from the exciting light. This may be due to traces of diimide, HN : NH, which is decomposed by violet light.

K. W. F. KOHLRAUSCH and ROMAN SKRABAL: Vibration spectrum of cyclobutane.

W. FLEISCHMANN, H. GOLDHAMMER and S. KANN: Physiology of hibernation.

HANS PRZIBRAM and LEONORE BRECHER: Inhibition of the red coloration of the fore-legs of *Dixippus*.

ATMA MALABOTTI: Functional and histological behaviour of the stick insect (*Dixippus morosus* Br. and Redt.) after severing the nerves of the head.

RUDOLF KANITSCHEIDER: Evaluation of the magnetic data of the Austrian expedition to Jan Mayen in the polar year 1932–33 (2). The diurnal variation of the magnetic elements.

# Official Publications Received

## Great Britain and Ireland

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 38: The Standardisation of Photo-electric Cells for the Measurement of Energy. By H. H. Poole and W. R. G. Atkins. Pp. 363–379. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*. 6*d*. [818

Mines Department. Fourteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1935. Pp. 144+10 plates. (London: H.M. Stationery Office.) 2*s*. net. [19

London Shellac Research Bureau. Technical Paper No. 10: Fundamental Physical Properties of Lac. Part 4: Optical Properties. By Dr. L. C. Verman. Pp. 16. (London: London Shellac Research Bureau.) [19

The National Institution of the Boot and Shoe Industry (Incorporated). Bibliographical Index: Boots and Shoes, Leather, Rubber and other Materials. Pp. xv+97. (London: National Institution of the Boot and Shoe Industry.) [19

County of Armagh Education Committee: Portadown and District Technical Schools. Time Table of Afternoon and Evening Classes, Session 1936–37. Pp. 24. (Portadown: Technical School.) [29

Institute for Research in Agricultural Engineering: University of Oxford. Refrigeration for the Farm and Dairy. By C. A. Cameron Brown. Pp. 51. (Oxford: University of Oxford.) 1*s*. 6*d*. [29

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1688 (2202): Measurement of Profile Drag by the Pitot-Traverse Method. By the Cambridge University Aeronautics Laboratory. Pp. 46+14 plates. 3*s*. net. No. 1690 (2261): Stressing of Aeroplane Wings due to Symmetrical Gusts. By L. W. Bryant and I. M. W. Jones. Pp. 20+25 plates. 2*s*. net. No. 1692 (1940): *Rolling Up of the Surface of Discontinuity Behind an Aerofoil of Finite Span.* By F. L. Westwater. Pp. 16+18 plates. 2*s*. net. No. 1696 (1868): Heat Dissipation of Ethylene Glycol Radiators and Comparison with Water Radiators. By C. Anderton Brown and F. G. Barlow. Pp. 28+17 plates. 2*s*. net. (London: H.M. Stationery Office.) [29

## Other Countries

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. Resident Birds of the Bay Islands of Spanish Honduras. By James Bond. Pp. 353–364. (Philadelphia: Academy of Natural Sciences.) [288

Field Museum of Natural History. Zoological Series, Vol. 20, No. 13: Records and Measurements of Neotropical Bats. By Colin Campbell Sanborn. Pp. 93–106. 15 cents. Zoological Series, Vol. 20, No. 14: Descriptions and Records of African Bats. By Colin Campbell Sanborn. Pp. 107–114. 10 cents. Zoological Series, Vol. 22, No. 1: African Reptiles and Amphibians in Field Museum of Natural History. By Arthur Loveridge. (Publication 360.) Pp. 112. 75 cents. Anthropological Series, Vol. 24, No. 1: Egyptian Stelae in Field Museum of Natural History. By Thomas George Allen. (Publication 359.) Pp. 80+43 plates. 1.50 dollars. (Chicago: Field Museum of Natural History.) [288

Publications of the Astronomical Institute of the University of Amsterdam. No. 5: The Stark Effect of Hydrogen in Stellar Spectra. By S. Verweij. Pp. 48. (Amsterdam: J. F. Duwaer and Zonen.) [288

University of California Publications in American Archaeology and Ethnology. Vol. 34, No. 4: Northeastern and Western Yavapai. By E. W. Gifford. Pp. v+247–346+plates 8–14. (Berkeley, Calif.: University of California Press.) [318

Annual Report of the Public Health Commissioner with the Government of India for 1934. Vol. 2. Pp. v+117. (Delhi: Manager of Publications.) 10 annas; 1*s*. [318

The Indian Association for the Cultivation of Science. Annual Report for the Year 1935. Pp. 44. (Calcutta: Indian Association for the Cultivation of Science.) [318

Indian Forest Records (New Series). Vol. 2, No. 3: A Stand Table for Chir (*Pinus longifolia*, Roxb.), Evenaged High Forest. Pp. iii+59–74. 12 annas; 1*s*. 3*d*. Vol. 2, No. 6: Zwei neue Callirrhipis mit ihren Larven (Sandalidæ, Col.). Von Fritz van Emden. Pp. ii+151–156. 4 annas; 5*d*. (Delhi: Manager of Publications.) [318

Summary Proceedings of the Thirty-second Meeting of the Indian Central Cotton Committee, Bombay, held on the 13th and 14th January 1936. Pp. 105. (Bombay: Indian Central Cotton Committee.) [318

Memoirs of the Geological Survey of India. Vol. 66, Part 2: Geology of the Northern Slopes of the Satpuras between the Morand, and the Sher Rivers. By H. Crookshank. Pp. viii+173–331+xx+plates 15–25. (Calcutta: Geological Survey of India.) 6.6 rupees; 10*s*. [318

Fiskeridirektoratets Skrifter, Serie Havundersøkelser. Report on Norwegian Fishery and Marine Investigations, Vol. 5, No. 2: A Study on the Life History and Migrations of the Norwegian Spring-Herring based on the Analysis of the Winter Rings and Summer Zones of the Scale. By Sven Runnström. Pp. 104+3 plates. (Bergen: A.s. John Griegs Boktrykkeri.) [19

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## Catalogues

Old Science and Medicine, comprising Astronomy, First editions of Tycho Brahe, Copernicus, Doppler, Galilei, Halley, Hevelius, Huygens, Kepler, Laplace, Sirturus, a Fine Collection of First Editions of Robert Boyle, Important Books in the History of Botany, Chemistry, Physics, Medicine, Anatomy, Embryology and Biology, Photography. ([illegible]50.) Pp. 64+6 plates. (London: E. P. Goldschmidt and Co., Ltd.)

Marconi—E.M.I. Television. Pamphlet No. M.E.M.I. 1: The System of To-day and To-morrow. Pp. 21. (London: Marconi—E.M.I. Television Co., Ltd.)

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